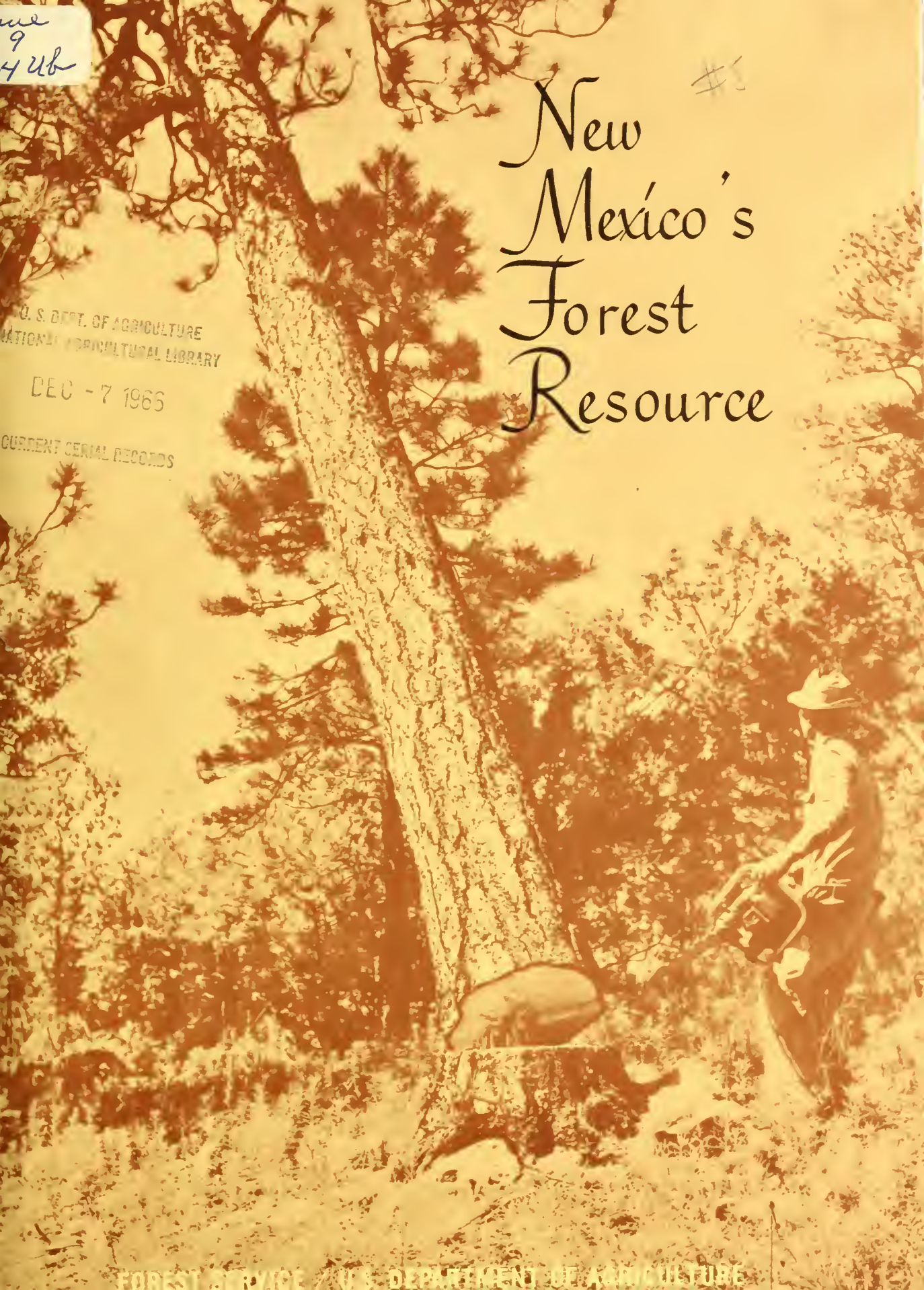
New Mexico's Forest Resource



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THE AUTHOR

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COVER PHOTOS

Photos showing timber harvesting (front cover) and forage, water, and recreation resources (back cover) illustrate some of the most important opportunities for multiple use management of New Mexico's forests.

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New Mexico's Forest Resource

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Foreword

This report is concerned primarily with timber. It presents figures regarding significant factors bearing on the present economics of this resource. Another purpose of the report is to describe some of the most important considerations that bear on greater development of the timber resource in the future. Other forest values — water, recreation, and forage — are discussed briefly. Trends in use of these resources must be considered in relation to timber, because practically no forest lands are managed for timber alone.

Timber inventory statistics in this report are the most reliable that have ever been collected for New Mexico's forests. The Southwestern Region of the U.S. Forest Service conducted surveys of National Forests, the Bureau of Indian Affairs of most Indian reservations, and the Intermountain Forest and Range Experiment Station of other lands. A survey of timber cut and timber products output was done on a cooperative basis by the Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, and the Intermountain Forest and Range Experiment Station, Ogden, Utah. The Intermountain Station compiled data from these various surveys for this report.

Meaningful comparisons cannot be made between inventory statistics in this report and those shown in the last two national timber appraisals. Differences in figures in this report from those for 1952 as shown in **Timber Resources for America's Future** (U.S. Forest Serv. 1958)[1] do not reflect actual changes in forest conditions. The 1952 figures were not based on a complete survey. Also, in the intervening years, there have been changes in standards for classifying trees and commercial forest land. Inventory statistics in **Timber Trends in the United States** (U.S. Forest Serv. 1965) were not based on a complete inventory and therefore do not agree with the figures in this report. The latter are based on fieldwork completed in 1962, but data were not available for the **Timber Trends** report because compilations were not finished until late 1964.

The appendix to this report should be consulted for definitions of terms, survey methods, reliability of estimates, and detailed timber statistics. The appendix also contains a generalized forest type map.

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[1]*Names and dates in parentheses refer to Literature Cited, p. 54.*

Contents

Statistical Highlights

FOREST AREA

- The forested area is 18.2 million acres, or 23 percent of New Mexico's land area.
- Commercial forests cover 6.3 million acres, or 34 percent of the forest land.
- 89 percent of the 11.9 million acres of noncommercial forest is classed as pinyon-juniper type.
- 69 percent of both the total forest area and the commercial area is in public ownership. The U.S. Forest Service administers 55 percent of the commercial forest.
- There are 1.9 million acres of private commercial forest, 80 percent of which belongs to farmers and ranchers.
- 87 percent of the commercial forest is in sawtimber stands, and these stands average 5,072 board feet per acre.[2]
- The ponderosa pine type occupies 69 percent of the commercial forest area.

TIMBER VOLUME

- Commercial forests have 6.6 billion cubic feet of wood in sound, live trees, and 28.3 billion board feet in sawtimber trees.
- About three-quarters of the sawtimber volume is publicly owned.
- The predominant commercial species in terms of sawtimber volume are ponderosa pine (57 percent) and Douglas-fir (18 percent).

STAND CONDITIONS

- 47 percent of the commercial forest area, and 54 percent of the sawtimber area are in old-growth timber.
- 50 percent of the gross cubic-foot growth is offset by mortality each year.
- Diseases accounted for 55 percent of annual sawtimber mortality, and insects 30 percent in 1962.

TIMBER USE

- New Mexico's timber cut of 40 million cubic feet from sound, live trees in 1962 was 0.6 percent of inventory. This is slightly less than the average cutting rate throughout the entire Mountain States area.[3]
- 78 percent of the volume of roundwood products cut in 1962 was saw logs for lumber.
- The harvest of roundwood products (cubic volume) was 14 percent greater in 1962 than in 1952. During the same period saw log production went up 107 percent but other roundwood decreased by 56 percent.
- A decrease in the number of active sawmills from 117 in 1960 to 85 in 1962 was largely at the expense of small mills. Average annual production per mill increased from 1.9 million in 1960 to 2.9 million in 1962.
- Ponderosa pine continued its traditional lead as the principal lumber species in 1962 and accounted for 54 percent of the cut.
- Catron County was the only county that had a saw log cut of more than 50 million board feet in 1962.

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[2] *In this report board-foot volume in saw logs and sawtimber trees is based on International ¼-inch log rule. Lumber volume is based on lumber tally.*

[3] *The following are considered Mountain States in this report: Montana, Idaho, Nevada, Utah, Wyoming, Colorado, Arizona, and New Mexico.*

Forest Use, Past and Present

Forests grow on 18.2 million acres, or nearly one-fourth of the lands in New Mexico. The forested area—high plateaus, mesas, and mountain ranges—occurs usually above 4,500 feet in elevation. The greater amount of rainfall at these elevations than elsewhere in the generally arid to semiarid State of New Mexico is the principal reason that these lands are forested and are outstanding in variety of values and uses.

Forest resources have played a very important role in New Mexico's development. The forest range has a particularly long history of use. Progeny of cattle, sheep, and horses brought in by Coronado in 1540 have grazed forested lands throughout succeeding centuries. Water from the high forested country stimulated agricultural settlement to begin with and has subsequently made it possible to irrigate almost 1 million acres of cropland. Timber harvesting has increased from the small amounts used for fuel and construction by settlers to nearly ¼-billion board feet a year. Hunting and fishing, which originally provided important sources of food, are now significant reasons for the booming development of outdoor recreation.

Forests can contribute much more to the future development of the State. In general, demands for forest resources are increasing rapidly along with the country's mounting population. An inevitable result is that forest management problems are increasing, especially on the nearly 70 percent of the forest land that is publicly owned. On these public lands the need for increasing yields of timber, water, and forage as well as recreation facilities within a fairly fixed area creates complex problems in multiple use management. Before going into future needs and problems, the next few sections describe past development and the current situation.

Lumber is the principal timber product

New Mexico has 6.3 million acres of commercial forest. These lands, which comprise about one-third of the total forest area of the State, are capable of growing crops of industrial wood and have not been reserved for other uses. In 1963, more than 2,200 people (almost one out of every seven manufacturing workers in the State) were employed in logging operations, or in sawmills, planing mills, millwork plants, wood preserving concerns, and similar primary wood conversion industries. Total employment in these industries was second only to that in food processing among all manufacturing industries[1] in New Mexico.

The preponderance of the volume of timber products cut in the State comes from public lands. National Forest, Indian, Bureau of Land Management, and State lands comprise 69 percent of the commercial forest area. These provided 64 percent of the 46 million cubic feet of products harvested in New Mexico in 1962. A report by Wilson (1964) on the yield of timber products in New Mexico in 1962 shows the following distribution of harvest by land ownership classes:

	Percent
National Forest	**43**
Other public	**21**
Private	**36**

Lumber has been New Mexico's principal timber product for a great many years. In 1962, saw logs cut for lumber accounted for 78 percent of the cubic volume of timber products harvested in the State as reflected by the following tabulation:

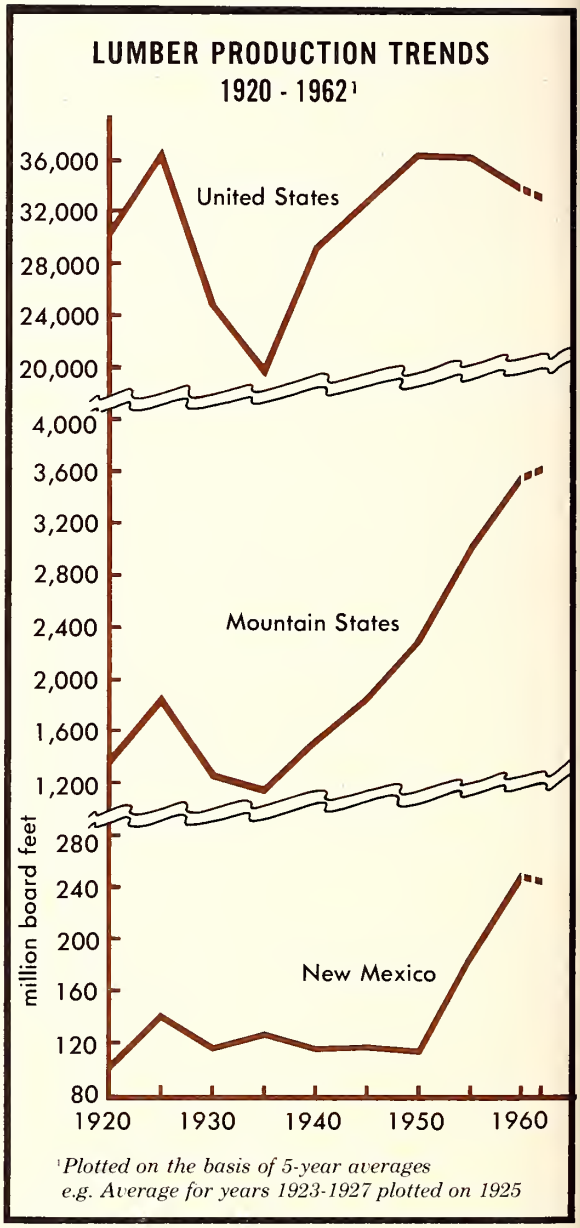
[1] *Industry classifications are those in the Standard Industrial Classification (SIC) of the U.S. Bureau of the Census. Timber industries included above all fall within SIC Code 24.*

	Volume harvested, 1962 *(Thousand cubic feet)*
Saw logs	35,905
Posts, fuelwood, misc. farm timbers	9,820
Mine timbers (round)	410
Misc. industrial wood	91
Poles	33
Total	46,259

Lumber production in New Mexico increased sharply after 1949 (see chart at right). The 1962 output of 245 million board feet (lumber tally) was little different from the average for the period 1958 to 1962. Between 1920 and 1960, New Mexico's lumber output increased about 2.4 times—thereby keeping pace with the average increase for the Mountain States and far exceeding the slight rise for the United States.

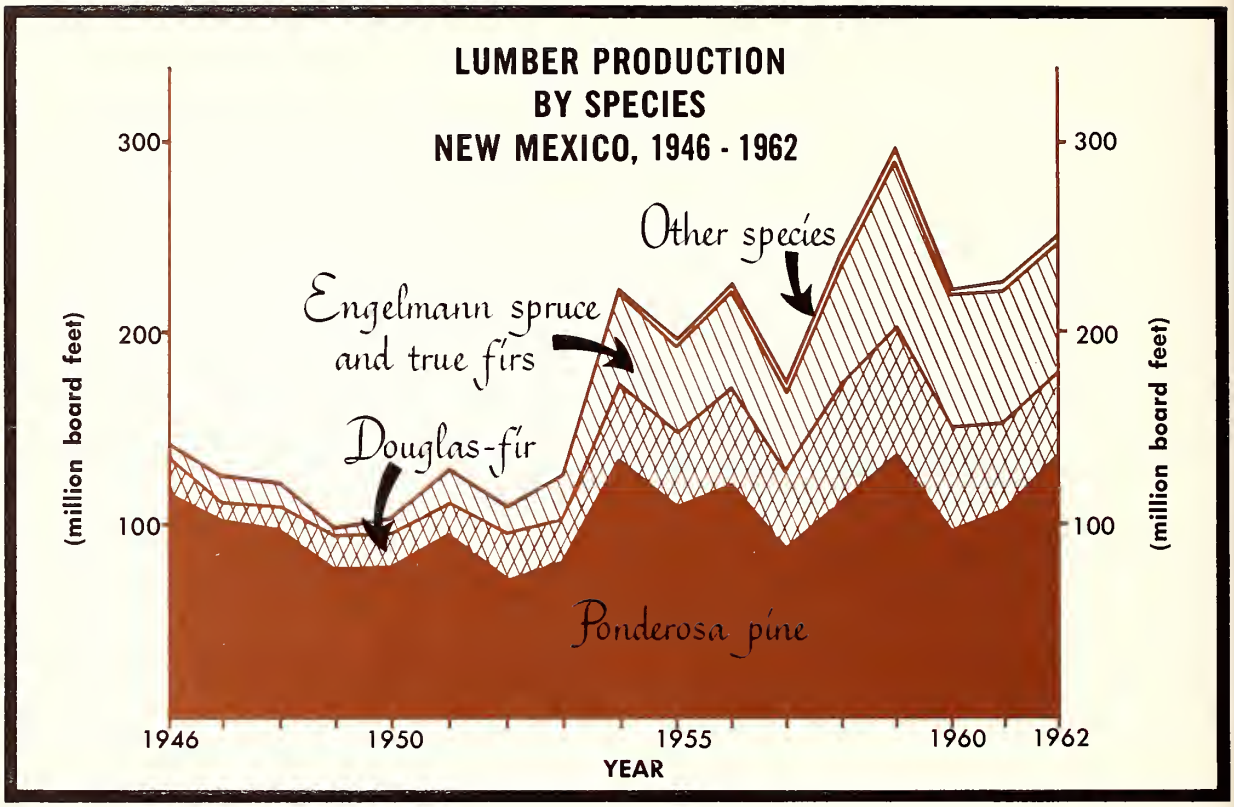
Almost three-quarters of the lumber sawn in the State since 1869 has been ponderosa pine; it is more abundant and generally more accessible than any other species in the commercial forest. However, the percentage has gradually decreased over the years and the estimated 134 million board feet of ponderosa pine saw logs cut for lumber in 1962 amounted to only 54 percent of the total of all species. The chart on page 4 shows changes among species for the period 1946 to 1962. The saw log output by species in 1962 was as follows:

	Million board feet
Ponderosa pine	133.7
Engelmann spruce	53.6
Douglas-fir	47.1
True firs	11.6
Other species	1.6
Total	247.6



[1]*Plotted on the basis of 5-year averages e.g. Average for years 1923-1927 plotted on 1925*

Sawmill of Navajo Forest Products Industries, Navajo. In this portion of the mill, boards are rough sorted and then moved by overhead crane (background) to be machine stacked and stickered before entering dry kilns. Built by Navajo tribal funds at a cost of about $6.5 million, this mill is one of the most modern in the industry. It includes two double cut band saws capable of producing 100,000 board feet per shift. Logs come mainly from reservation lands in New Mexico and Arizona, which have an allowable cut of 38.6 million board feet a year.



NEW MEXICO SAWMILLS AND SAW LOG PRODUCTION 1962

● Sawmill reported as operating in 1962[1]

★ City

Saw log output by counties (million board feet)

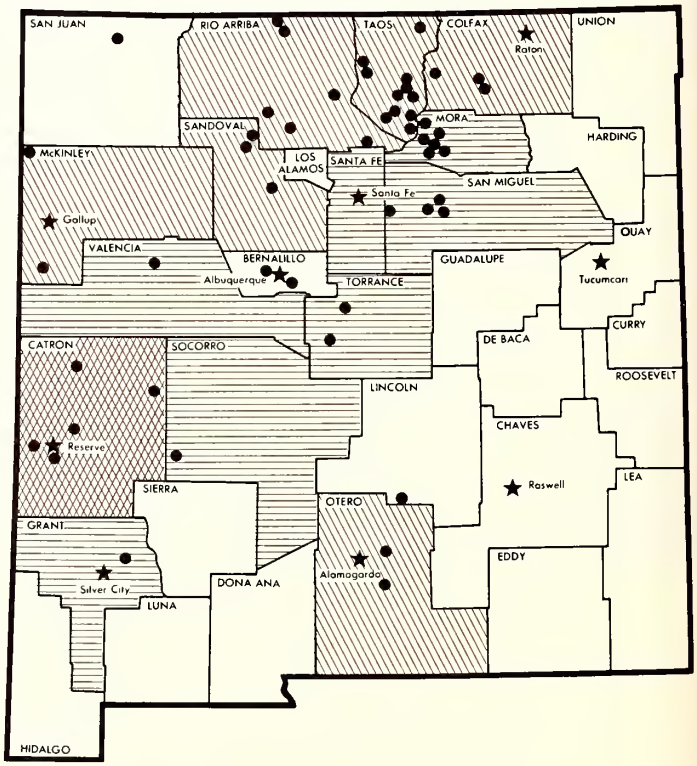
No reported production

Less than 10

10 to 50

50 to 100

[1]In addition to the mills shown, there were active mills that either did not furnish a report in the 1962 timber products survey, or whose report did not contain adequate information for locating on the map.



Sawmills come and go

Sawmilling is by far the biggest timber industry in New Mexico. In 1962, there were 85 sawmills operating, while there were less than 25 enterprises engaged in harvesting or processing materials such as converter poles, building logs, round mine timbers, posts, poles, and fuelwood.

The map on the facing page shows the location of sawmills that reported production in the 1962 forest products survey. It also shows saw log output by counties, of which only Catron had a production of more than 50 million board feet.

Instability is a characteristic of New Mexico's sawmill industry. Between 1889 and 1947, the number of mills increased gradually from 24 to 162, although there were many sharp fluctuations in the general trend. Since 1947, the trend has been reversed. Here again, there have been ups and downs as indicated by data available for these years:

	Active sawmills
1948	120
1954	88
1958	70
1960	117
1962	85

Distribution of mills by size class in 1962 was as follows:

Size class *(Thousand board feet per year)*	Active mills
Less than 50	12
50 to 199	16
200 to 499	10
500 to 999	16
1,000 to 4,999	19
5,000 and over	12
Total	85

[1]*Mill size class estimated from reported saw log receipts rather than lumber production.*

During the decline from 117 mills in 1960 to 85 in 1962, dropouts were particularly numerous among smaller size mills. This has been a general trend throughout the Mountain States in recent years. Fewer but larger and more efficient mills, together with a generally rising timber demand, have resulted in substantially greater average production per mill. In recent years, this increase has been 22 percent a year in New Mexico and 11 percent in the Mountain States as a whole.

Tractor skidding ponderosa pine logs on a New Mexico Timber Company operation, Santa Fe National Forest.

Timber cut volume and product values are low

In several ways, New Mexico is representative of the general or average level of timber harvesting in the Rocky Mountain States. In 1962, New Mexico cut 0.60 percent of its inventory of sound live trees. This is well above the 0.22 percent for the lowest State (Utah) and substantially less than the 1.08 percent for the highest (Arizona). The following figures permit comparisons with averages for the Rocky Mountain States and the country:

	Percent of cubic volume inventory cut, 1962
New Mexico	**0.60**
Mountain States	**.69**
United States	**1.61**

The situation is about the same when sawtimber cut is considered in relation to sawtimber inventory.

Economic considerations that hinder more timber harvesting are also much the same in New Mexico as in the Rocky Mountain area as a whole. A number of factors make production costs high in relation to product values. Access roads are expensive to build in the rugged terrain typical of much of the best timberland. Frequently, it is impossible to build roads that will not impair watershed values or cause erosion and still leave the operator a margin for profit and risk if construction costs must be borne by the timber alone. These costs could be borne if timber volumes were greater and quality better. However, compared to such areas as the west coast, volumes per acre are lower, logs are smaller and of poorer quality, and stands are less extensive in area. These natural disadvantages pose difficult problems as New Mexico seeks to expand markets for its wood products outside as well as within the State. An economic study of New Mexico timber industries (Long 1965) showed that in 1962 New Mexico exported 138 million board feet to other States and imported 137 million board feet of lumber, as well as 33 million square feet of plywood.

Data on value added to timber in harvesting and further processing provide a basis for certain economic comparisons. In 1962, New Mexico's timber industries added a value of $265 per thousand cubic feet of roundwood products harvested. This compares with $360 for the Mountain States as a whole. New Mexico, unlike Idaho, Montana, and Arizona—the leading timber-processing States in the Rocky Mountain area—does not have any plants that produce high-value products such as plywood, pulp, and paper. These industries, together with the opportunities they provide for integrated and efficient production processes, are a substantial benefit to the economy. However, as discussed later in this report, there are opportunities for such industries in New Mexico.

Forest lands are the principal source of water

None of the many values of New Mexico's forest area is more vital than that of water. The yield of surface water from the 36 percent of the area of the State that is in forests and intermingled openings within the elevational range at which trees grow constitutes almost 60 percent of the 2.7 million acre-feet of runoff from all lands.

Most of the streams that drain New Mexico's forests are headwaters of three of the country's major rivers—Colorado, Rio Grande, and Mississippi. However, some streams drain into a number of closed basins that do not discharge into these three rivers.

All of the significant streams are subject to interstate water compacts.

A recent report (Hale et al. 1965), which shows that water outflow from the State is about 23 percent greater than inflow, indicates that New Mexico is not using all of its water. When fully developed within limits of interstate compacts, outflow from the State will approximately equal deliveries into the State under the compacts (State of New Mexico 1959).

Demands for more water from forests and other lands probably will come mainly from municipal and industrial users. These users now account for only about 2 percent of the surface water consumed in various human activities but are expected to increase sharply along with the State's population which is expected to double by 2000.

Opportunities exist for substantially increasing the runoff from forest lands. Research in a number of places, including studies in the Southwest, show that the volume and timing of runoff can be improved by manipulating the kind and amount of tree cover. However, the extent that this can be done economically in relation to other values of the land will have to be carefully evaluated for each local situation.

Forage and wildlife uses are very important

The forest range has a long history of heavy use for livestock and big game forage. Overuse has occurred on much of the ponderosa pine, pinyon-juniper and other forested ranges, particularly during the livestock boom in the early 1880's. The number of cattle in New Mexico increased from 158,000 in 1870 to 545,000 in 1880 and to 1,065,000 in 1886. During the peak year for sheep —1882—about 5.2 million head grazed New Mexico ranges. Depletion of the range during these years, combined with blizzards and droughts, resulted in a collapse of the boom. One of the most important consequences of this period of overuse was a damaged range depleted forage—and a deteriorated soil mantle. Damaged range-

Sheep grazing in openings within the Carson National Forest. In 1963, 58,000 sheep and 85,000 cattle grazed under permit on the National Forests in New Mexico.

lands do not recover rapidly under climatic conditions that prevail in the Southwest, and many areas still bear scars of early misuse.

Establishment of National Forests in New Mexico, beginning in 1899, was an important step in bringing extensive areas of forest range under controlled use. However, it was not until after demands for livestock products eased following World War I that substantial improvement could be made in range use in relation to capacity. Between 1917 and 1963, the number of head of cattle that grazed on National Forests in New Mexico declined by 56 percent, and the number of sheep declined by 89 percent.

Range management has gradually improved over the last few decades. Today public land management agencies and many private interests have active programs that involve range inventories, revegetation, control of undesirable plants, deferred and rotation grazing, seasonal use, and such structural improvements as fences and water developments. On the National Forests, in 1964 for example, these were accomplished as follows: revegetation through seeding, 6,354 acres; plant control, 9,650 acres; erosion control, 1,005 acres; and fencing, 330 miles. Some of this work was done in cooperation with grazing permit holders.

Many species of wildlife are also important users of forest lands. There is no evidence that buffalo, deer, and other big game species, the original users of the forest range, had any important effect in depleting the range. However, subsequent use of forest lands for livestock, timber, and recreation, together with accelerating demands for hunting, have made it necessary to improve habitat conditions. Programs of public land management agencies, some in cooperation with the New Mexico Department of Game and Fish, include seeding to forage species, control of noxious plants, creation of wildlife openings, and development of water sources.

Recreation use has increased very rapidly in recent years

Among the various uses of New Mexico's forest lands, recreation has experienced the most spectacular gains since World War II. There are also indications that recreation traffic in New Mexico's forests has multiplied more rapidly during these years than in most parts of the country. Although comprehensive statistics are not available to show recreation use of all forest lands, estimates of the number of visits by recreationists to National Forests do permit certain comparisons among States.

The nearly 5 million visits made to National Forests in New Mexico during 1963 for camping, hunting, skiing, and many other activities amounted to 14.7 times the number of visits recorded for 1946. In this respect, New Mexico was exceeded among the Mountain States only by Arizona for which the number of visits in 1963 was 15.6 times that for 1946. Recreation traffic on New Mexico's forests increased many times more than the averages for the Mountain States or the nation as a whole.

	Number of recreation visits		*Number of times increase*
	1946	1963	
	- - (Thousands) - -		
New Mexico	**336**	**4,940**	**14.7**
Mountain States	**6,293**	**49,777**	**7.9**
United States	**18,241**	**122,582**	**6.7**

Many factors contribute to the boom in forest recreation in New Mexico. Here, as in other parts of the country, participation in outdoor recreation has roughly paralleled the rise in amount of leisure time, disposable income, and mobility of vacationers. There are other considerations that particularly favor New Mexico and the Southwest in general. New Mexico's population increase of 40 percent between 1950 and 1960, although only slightly higher than for the Mountain States as a whole (35 per-

cent), was more than double the percentage of the nation as a whole. One reason for this might be New Mexico's climate which is conducive to year-round outdoor activity.

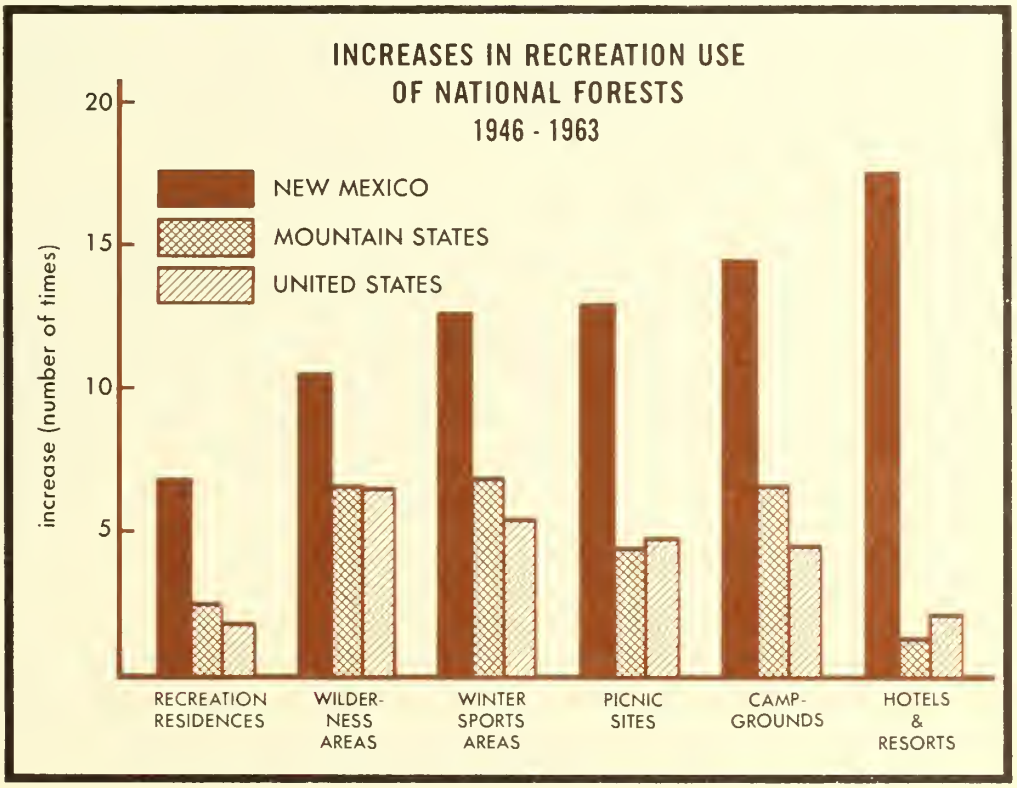
The chart below reflects the increasingly important role that New Mexico is assuming in meeting today's growing demand for outdoor recreation. Note the particularly big increase in visits to hotels and resorts in New Mexico as compared to other parts of the nation. Possibly this is because of greater opportunity for year-round occupancy in New Mexico.

Skiing is one of the most rapidly developing recreational uses of New Mexico's forest lands. Attendance at ski resorts has increased much more rapidly in New Mexico since 1955 than in any other western State. This is indicated by results of a recent comprehensive study of ski business in the west,[5] which shows that for the period 1955 to 1964 attendance at ski areas in New Mexico increased at an annual compound rate of 31 percent. This is about twice the average rate for the Western States.

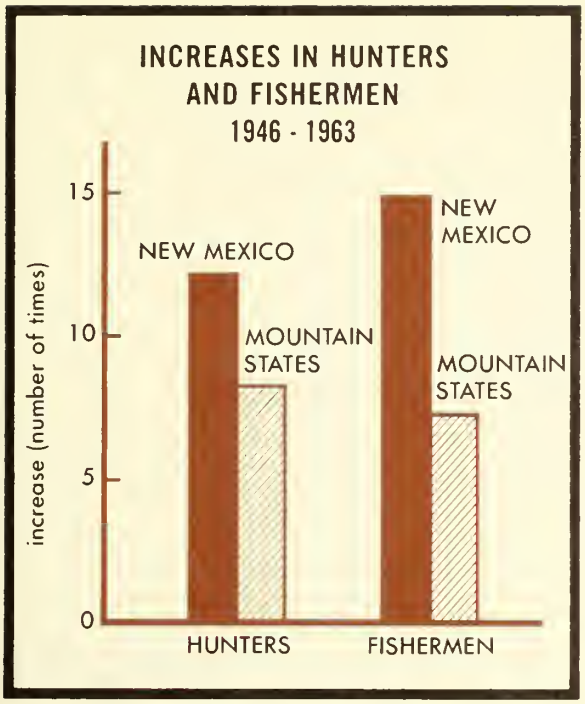
Hunting and fishing uses have also shown relatively sharp upward trends in New Mexico. Increases on National Forests in New Mexico are well above the average for the Mountain States as a whole (see chart page 11).

The surge in recreation use in the postwar years has had a substantial impact on forest resource management. This is particularly the case on public lands. Except for the relatively small forested area within National Parks and Monuments where management is directed towards maintaining scenic and historical values, practically all public lands are managed on a multiple use basis. The U.S. Forest Service, for example, is currently examining National Forest lands, acre by acre, and prescribing management practices; such characteristics as soils,

[5]*The study was conducted by the U.S. Forest Service at the request of the Economic Development Administration. A report is in process.*



Dwellings in the resort town of Cloudcroft within the Lincoln National Forest. The rapid increase in recent years in the number of residences and resorts situated in the forest and used primarily by recreationists for year-round activities is a significant development. Such active and growing communities as Cloudcroft and Ruidoso not only provide respite from the summer heat of southern New Mexico and west Texas but also permit a wide range of activities — picnicking, camping, fishing, horseback riding, etc. Winter and fall activities include skiing and hunting. These various pursuits provide big opportunities for private enterprises catering to recreationists. Many of the dwellings and resorts are located on private lands; others are built under permit or concession on public lands.



terrain configuration, drainage, and vegetation are considered as they relate to anticipated demands for water, timber, recreation, forage, and wildlife.

Efficient management also requires coordination among public agencies. For example, the New Mexico Department of Game and Fish is responsible for management and protection of wildlife, while public land agencies are concerned with maintaining and improving habitat. Close cooperation is needed to assure sustained yields of game and fish.

Elk foraging in ponderosa pine forest on the Santa Fe National Forest. Big game hunting — principally for deer, elk, and black bear — is one of the most important recreational uses of forest land. Photo courtesy of New Mexico Department of Development.

The Forest Today

New Mexico's 18.2 million acres of forests grow on the highlands, roughly within the elevation range of 4,500 to 12,000 feet above sea level. The amount of water that falls on these lands each year varies with elevation from about 12 inches at the lower limit of the forest to 35 inches at the higher. Vegetation at elevations below the forest is largely grasses, sagebrush, and desert shrubs; above the forest it is alpine sedges, grasses, and herbs.

Within the broad band of forest there is a general zonation of tree species in relation to elevation. However, considerable variation is found because of climatic and physiographic influences such as direction and steepness of slope, soils, etc. (photo on facing page). In general, however, the principal types occur as follows:

Type	Characteristic trees	Elevation (Feet)
Fir-spruce	Engelmann spruce Subalpine fir Corkbark fir Limber pine	8,500-12,000
Douglas-fir	Douglas-fir White fir Aspen[1] Ponderosa pine Limber pine	8,000-9,500
Ponderosa pine	Ponderosa pine Arizona pine	5,500-8,500
Pinyon-juniper	Pinyon Juniper species	4,500-7,500
Oak brush and woodland[2]	Oak species	3,600-4,800

[1]*Where aspen predominates, it is recognized by Forest Survey as a separate type.*

[2]*Oak brush and woodland are classed by Forest Survey in the general category known as chaparral. Such lands are so designated in the statistical tables and generalized type map in the Appendix.*

The geographic locations of the timber types are shown by the map in the Appendix.

Only 6.3 million acres, or roughly one-third of the forest area, support timber of commercial importance. The remainder is designated noncommercial. Before discussing the commercial forest — the principal concern of this report — the following section briefly describes the noncommercial forest.

Noncommercial forests cover 15 percent of New Mexico

Although of little importance for timber production, the 12 million acres of noncommercial forest are valuable for a combination of other uses. A major portion of the area provides forage for livestock and game. While water yields are less per acre on the average than from the commercial forest, they provide a significant source of supply for people in the semiarid lowlands. About 964,000 acres are reserved primarily for recreation. These include National Parks and Monuments as well as wild, wilderness, and primitive areas within National Forests. Actually, about 561,000 acres of this reserved land are productive and would be considered commercial forest were they not set aside for other uses. The following tabulation shows the total acres for various classes of noncommercial forest:

	Thousand acres
Reserved-productive	561
Reserved-unproductive	403
Unreserved-unproductive	10,954
Total	11,918

Almost nine-tenths of the total noncommercial forest is pinyon-juniper lands that are found at the lower elevations of the

Stand of Douglas-fir (background) on a north-facing slope and ponderosa pine (foreground) on a hotter and drier south-facing slope. This photo, taken just east of Mogollon in the Gila National Forest at an elevation of about 8,500 feet, illustrates the difference that can occur in type of tree cover in relation to direction of slope.

Photo on the facing page shows noncommercial forest in Frijoles Canyon, Bandelier National Monument. This reserved area includes both productive lands (such as the ponderosa pine stand in the center of the photo) and unproductive lands (the pinyon-juniper hillside). In the small clearing are ruins of a Pueblo Indian dwelling called "Rainbow Room," which was constructed in the period 1200 to 1537 A.D.

Photo to the right, taken near Los Alamos, illustrates pinyon-juniper lands. Improved fire protection has resulted in the invasion of pinyon and juniper trees into many areas of grassland. This has generally meant a deterioration of forage production on such lands. However, extensive areas have been cleared of pinyon and juniper in recent years and sowed with forage grasses for livestock and game.

forest. Another 5 percent is oak brush which also grows at low elevations. The remaining 5 percent consists of areas of ponderosa pine, fir-spruce, and other types that grow where soils or climate are unfavorable—either as patches within the predominantly commercial forest zone, or as the upper fringe of the forest; i.e., just below timberline.

The 10.6 million acres of pinyon-juniper type in New Mexico support a big volume of wood—about 1.7 billion cubic feet of which roughly one-half is pinyon and one-half juniper. Despite this large volume, only a small percentage is harvested for posts, fuelwood, and charcoal—the principal wood products. Pinyon is gaining popularity as a Christmas tree and in 1963 accounted for roughly 15 percent of the estimated cut of 350,000 Christmas trees in the State.

The extent to which pinyon-juniper lands can be made more productive is a very important consideration in the management of New Mexico's wildlands. Probably the greatest opportunities lie in improving the land for forage, although some areas may be suitable for agricultural crops. Where these are the objectives, eradication of pinyon and juniper trees will usually be necessary because of their inhibiting effect on desirable vegetation. Many areas have already been cleared and improved. Reliable estimates of additional acreage on which improvement is justifiable are not possible without detailed surveys of potential land use.

Sawtimber stands predominate in the commercial forest and run heavily to old growth

New Mexico's 6.3 million acres of commercial forest support a timber stand of 6.6 billion cubic feet in sound live trees 5 inches and larger in diameter at breast height (d.b.h.). Sawtimber trees have a volume of 28.3 billion board feet of which 98 percent is in sawtimber stands.

New Mexico has a relatively high proportion of commercial forest in sawtimber stands (87 percent) as compared to the Mountain States as a whole (59 percent). However, volume per acre in sawtimber stands (5,072 board feet) is the lowest of any of the Mountain States and is not much more than one-half the Mountain States' average (9,957).

Forty-six percent of New Mexico's 27 billion board feet of softwoods is in trees 19 inches and larger. However, there are substantial differences among species:

	Percent of sawtimber volume in trees 19.0 inches and larger
Ponderosa pine	**54**
Douglas-fir	**42**
True firs	**32**
Engelmann spruce	**26**

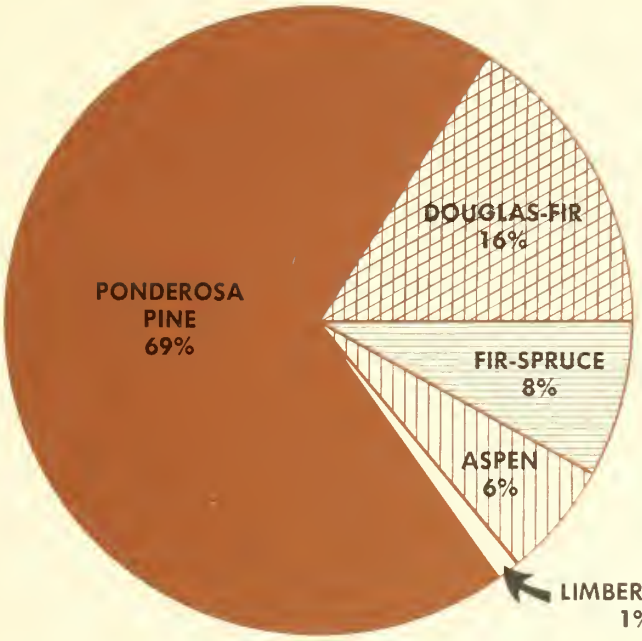
About 47 percent of the commercial area is occupied by old-growth stands; i.e., stands in which the dominant trees are more than 120 years old. Private lands, being more accessible, have proportionately less old growth (37 percent) than public lands (52 percent).

Poletimber, seedling, and sapling stands account for slightly less than 10 percent of the commercial area. The nonstocked area (220,000 acres) is only 3.5 percent of the total.

Although there is a relatively small area of poletimber, sapling, and seedling size classes, this does not mean that reproduction is lacking. Many present stands have trees of several age classes and of all sizes. About one-eighth of the cubic-foot volume of sound live trees in sawtimber stands is actually in trees of pole size. Although most ponderosa pine stands consist of trees of several age classes at the present time, the objective on National Forests is to convert the forest gradually to even-aged stands.

Ponderosa pine is the principal timber species

Very few States in the country have as high a percentage of commercial timber area and volume in one species as New Mexico has. Almost three-fifths of the State's volume of sound live trees is ponderosa pine. Ponderosa pine is the predominate species on more than two-thirds of the commercial lands. The other commercial species that occur most frequently are Douglas-fir, Engelmann spruce, true firs (subalpine, corkbark, and white), aspen, and limber pine. These species occur in five timber types recognized by Forest Survey—ponderosa pine, Douglas-fir, fir-spruce, aspen, and limber pine. The charts at right indicate the relative importance of the species and types. Most of the important species are illustrated by photos and described on the following pages. Limber pine is one of the species not illustrated. Although of minor importance for timber production, limber pine is significant for watershed protection. It grows in small and scattered patches at high elevations—on 43,000 acres as a type, and elsewhere as individual trees in the fir-spruce and Douglas-fir types. Because it usually grows on poor sites—thin-soiled and exposed to high winds—trees are generally short and of poor form. Although the inventory shows a volume of 640 million board feet, little is cut each year.

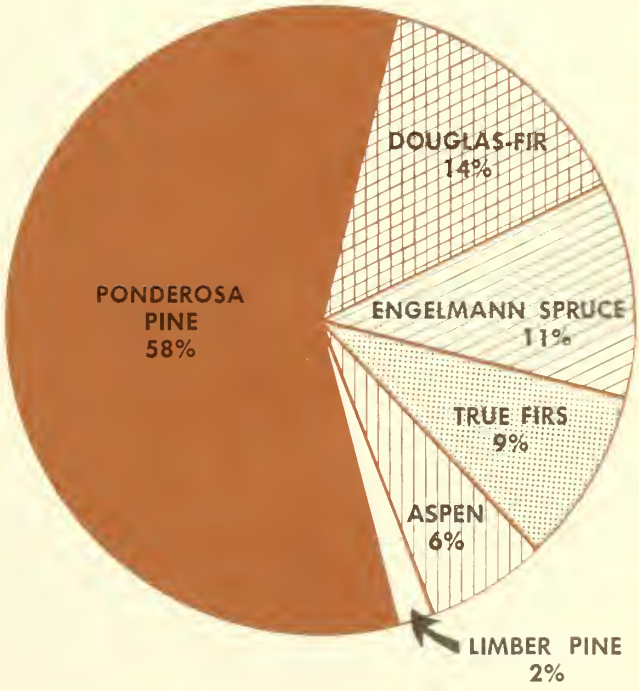


AREA BY TYPE

PERCENT OF 6.3 MILLION ACRES OF COMMERCIAL FOREST

VOLUME BY SPECIES

PERCENT OF 6,616 MILLION CUBIC FEET IN SOUND LIVE TREES



Ponderosa Pine Forests

Shown at left is a ponderosa pine stand. This stand, which is in Jemez Canyon on the Santa Fe National Forest, remains after a partial cut made some years ago. The site is better than the average for ponderosa pine in New Mexico. The large trees are mature, 20 to 22 inches d.b.h., and about 120 feet tall.

Stands such as this, supporting few sawtimber trees but many poles, seedlings, and saplings, are among the 3.9 million acres of sawtimber that comprise 90 percent of the commercial area of ponderosa pine. The remaining area is poletimber (4 percent), seedling-sapling (2 percent), and nonstocked (4 percent).

Ponderosa pine has always been the mainstay of the timber industry in New Mexico. Large-scale use began after construction of the first railroads, and between 1878 and 1881 ponderosa pine forests near Las Vegas, Pecos, and Santa Fe were heavily exploited for ties and construction materials. Versatility of ponderosa pine wood subsequently brought it into big demand for many other uses; i.e., poles, posts, mine timber, and — most of all — lumber. About 73 percent of the 7.5 billion board feet of lumber that has been cut since sawmilling began in New Mexico has been ponderosa pine. Although other species have gradually increased in relative importance (see graph page 4), ponderosa pine still accounted for 54 percent of the total lumber output for the State in 1962.

Early logging practice, whereby select trees were "highgraded" from most of the ponderosa pine stands, is a principal reason that top quality saw logs are scarce today. Less than 1 percent of the saw logs in the present forest can qualify as **select** (grade 1); about 83 percent of the inventory is classed as **low common** (grade 4). However, as discussed later in this report, markets for low-grade sawtimber will be bolstered if such products as veneer and plywood can be produced economically.

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[6] *A system of four grades was used in the inventory on which this report is based. See Terminology in the Appendix.*

Douglas-Fir Forests

Shown at left is a Douglas-fir stand of large sawtimber. Mature and well-stocked with many trees 115 feet tall and 20-24 inches d.b.h., this stand is on the Santa Fe National Forest.

In New Mexico, Douglas-fir grows as a timber type on 1 million acres or 16 percent of the commercial forest area; in this respect it is second only to ponderosa pine. Douglas-fir seldom grows in pure stands. Within the general 8,000- to 9,500-foot elevational range of the species, it mixes with ponderosa pine at the lower end of the range and with true firs and spruce near the upper limits. White fir and aspen are common associates throughout the Douglas-fir type.

Ninety percent of the area of Douglas-fir type is classed as sawtimber. These stands almost always contain several age classes, which present good opportunities to organize into even-aged stands. They consist of overmature sawtimber trees with an understory of poles, saplings, and seedlings.

The area of the Douglas-fir type is tending to increase at the expense of other types. Many present stands of aspen and ponderosa pine have an understory of Douglas-fir and white fir that will eventually replace the overstory unless management practices or fire change the trend in succession.

Douglas-fir is suitable for many uses. Timber has been sawed into boards, dimension stock, sheathing, flooring, and railroad ties for many years. Prior to 1962 Douglas-fir was almost always second to ponderosa pine in volume sawed for lumber. However, in 1962 the cut of Douglas-fir (47 million board feet) fell to third place behind ponderosa pine and Engelmann spruce. Christmas tree production is another significant use of both Douglas-fir and white fir. The estimated 1963 harvest of these two species (about 245,000 trees) accounted for about 70 percent of all Christmas trees cut in the State.

Douglas-fir lands are found at high elevations at which temperatures are relatively cool. This makes them attractive as sites for summer homes, as well as for year-round outdoor recreation activities.

The most significant value of these lands, however, is undoubtedly water. Many of the Douglas-fir sites are steep, rocky slopes with thin soils where erosion control and watershed protection are paramount. A comparison of the mean annual precipitation of Douglas-fir lands (25 inches) with that of the State as a whole (15 inches) indicates their importance in terms of water runoff per acre.

Fir-Spruce Forests

Shown ot left is o fir-spruce stand. Located on the Sondio Crest road at an elevotion of obout 9,500 feet, this is a medium site for spruce. It is on overmoture stand with many sawtimber trees that are 18 inches d.b.h. ond 85 feet toll.

Fir-spruce stonds, which are found for the most part just below upper timberline, hove o mixture of species. Engelmann spruce is the most importont commercial tree, although subolpine firs are generally os numerous in the stond. Other species that occur less frequently include corkbark fir, white fir, ond Douglas-fir, as well as limber ond bristlecone pines.

About 85 percent of the area of the fir-spruce type consists of sawtimber stonds, most of which ore overmoture. Young trees, such os seen in the photo, are usually present in these old stands. Most of the oreo that is not in sawtimber is stocked with poles or smaller trees; only o minor oreo is nonstocked.

Engelmonn spruce and — to a lesser extent — true firs have been gaining significantly in importance for timber use (see chart p. 4). Although these species have contributed only obout 11 percent of oll lumber produced since lumbering begon, they accounted for about 26 percent in 1962. For that year Engelmonn spruce wos second only to ponderosa pine.

Although the orea of the fir-spruce type is relotively smoll (0.7 million acres of commerciol ond noncommercial combined), it is very important for water yields. These lands receive more precipitation per acre thon any other closs of forest, ond woter runoff is therefore high. Recreation values ore olso significant, porticulorly for wilderness trovel; the 122,000 acres of productive reserved area of the type is procticolly oll in wilderness, primitive, or wild oreos in Notional Forest.

Aspen Forests

Shown at left is an aspen stand west of Los Alamos. Trees in this mature stand are of better than average quality. They average about 85 feet tall and 10 to 14 inches d.b.h. Sawtimber stands[7] make up almost one-half of the 367,000 acres of commercial aspen in the State. More than the other species found in the State, aspen grows almost entirely in single-aged stands, many of which originated after fires within the last 100 years. An understory of mixed conifers is common; the almost pure understory of ponderosa pine shown in this photo is somewhat exceptional.

Although little aspen is being harvested at present, the situation could change. This species is well suited for pulpwood, excelsior, core stock, and lumber for certain uses, and demand for such could well develop in New Mexico as has been the case in many other areas. Yet, there are some who argue in favor of converting aspen areas to Douglas-fir, white fir, and other species now in demand. They reason that many areas on which aspen is now found have a potential for greater yields of sawtimber if stocked with conifers.

However, conversion of most aspen stands to conifers would be undesirable from the standpoint of other resource values. The root sprouts, forbs, and other understory vegetation in aspen stands are excellent forage for big game and livestock. On well-managed lands aspen is considered as satisfactory as conifers from the standpoint of watershed protection. However, it is a better soil builder. The brilliant autumn foliage of aspen is one of the main scenic attractions of the forest.

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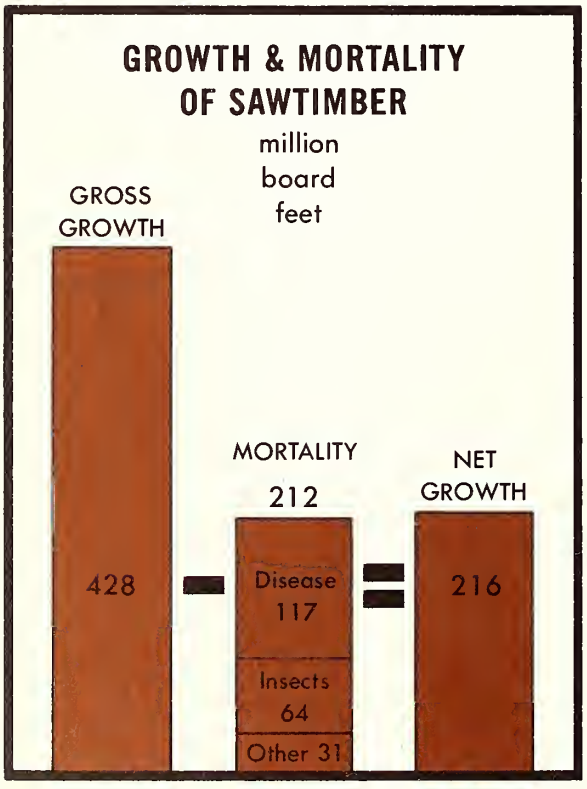
[7]*The minimum d.b.h. for aspen and other hardwood sawtimber is 11.0 inches; for softwood sawtimber it is 9.0 inches.*

The old-growth timber is susceptible to high mortality

The 212 million board feet in sawtimber trees that die each year in New Mexico's forests amounts to 0.75 percent of the sawtimber inventory (28.3 billion board feet). This mortality rate is somewhat less than that for the Mountain States as a whole (0.96 percent) and mortality volume is well below the gross growth of 428 million board feet.

Mortality rates vary substantially among species. It is particularly high in aspen, which has an annual mortality loss of 4.08 percent of sawtimber inventory—practically all caused by diseases and insects. Engelmann spruce and ponderosa pine are relatively low with rates of 0.10 and 0.25 percent, respectively.



Although roughly 23 million board feet of dead trees were salvaged in 1962 for saw logs and 8.3 million cubic feet for other products, there was still a big net loss of timber suitable for harvesting. More intensive harvesting and management, as discussed later in this report, would preclude much of the sawtimber mortality as well as some of the annual mortality in poletimber (11 million cubic feet).

The principal causes of mortality are diseases, insects, weather (mostly lightning and wind), and fire. The relative importance of these destructive agents can vary greatly from year to year. Only the effects of disease are fairly constant; the others can go up and down very rapidly. Pearson (1950) indicates that lightning and wind are the most widespread causes of mortality in ponderosa pine. However, Forest Survey records show that for the period 1958 to 1962, 55 percent of sawtimber mortality for all species was caused by diseases, 30 percent by insects, and the remaining 15 percent by weather, fire, and other factors.

Dwarfmistletoe is very widespread and undoubtedly causes a greater loss of growth than any other disease. A 1960 report (Andrews and Daniels) indicates that 40 percent of the ponderosa pine in New Mexico is infected, and that infection is especially heavy in virgin stands. It is also present in stands of Douglas-fir and other conifers. The inhibiting effect of dwarfmistletoe on growth is indicated by significantly less merchantable volume per acre and a higher incidence of mortality in the more heavily infected stands. In New Mexico, dwarfmistletoe is particularly abundant in the White Mountains and the Sacramento Mountains.

Of the other diseases, red rot, which is very common in old-growth ponderosa pine trees, is by far the most destructive at present. However, a species of root rot that has a potential for being the most destructive disease of all has been found in several places in the Southwest.

Insects also cause a big loss in timber volume in New Mexico's forests. Insect attacks usually fluctuate much more from year to year than disease, and are frequently of explosive proportions. For example, while

bark beetles in ponderosa pine and true firs remain endemic over long periods, big outbreaks can occur when stands are in a weakened condition. This is what happened in 1956 following a prolonged drought. As a result, mortality from bark beetles reached an all-time high in 1957 when more than 600 million board feet of sawtimber was killed in the Southwest. Engelmann spruce, though less extensive in area than ponderosa pine, can also incur heavy and rapid mortality from epidemics of the Engelmann spruce beetle. This is especially likely to happen unless blowdown trees and debris from logging and road construction are either used or burned immediately.

The most significant insect infestations in 1964 were by spruce budworm on two large areas of mixed conifers—one of 350,000 acres near Chama and Cimarron, the other on about 130,000 acres of the Gila and Lincoln National Forests in southern New Mexico.

Lightning, blowdown, and fire are also very important causes of mortality. In 1962 these were the principal factors in the loss of about 31 million board feet of sawtimber. Big variations occur, however, from year to year because of differences in weather conditions. For example, fire statistics for the years 1958 to 1962 show an average annual burn of 11,804 acres of forest land, but for individual years the burn ranged from 4,762 acres in 1958 to 19,835 in 1962. Long-term statistics indicate a fairly steady increase in number of fires each year. Intensified fire control efforts, however, have tended to reduce the size of individual fires.

Timber yields can be substantially increased

The commercial forest of New Mexico is growing at the rate of only a little more than 8 cubic feet per acre per year. The annual yield potential of growing stock volume, even without harvest of thinnings, is much higher—about 38 cubic feet per acre. For the

Blowdown of Engelmann spruce. Windthrow is an important cause of mortality in old-growth stands of spruce and fir, such as this one at a high elevation on the Santa Fe National Forest. Down trees are choice host material for the Engelmann spruce beetle. Unless salvage and slash treatment action is prompt, catastrophic losses can occur in adjoining stands.

total 6.3 million acres of commercial forest in New Mexico, therefore, the potential yield is roughly estimated at 240 million cubic feet, which includes about 875 million board feet of sawtimber.

These figures do not take into account subordination or elimination of timber production in favor of such uses as watershed development and recreation. Greatly increased growth rates would also require a vigorous and prolonged program of stand improvement and other cultural effort. Nevertheless, these figures do indicate that New Mexico has a substantial untapped growth capacity, should the need arise.

Something like 31 percent of the commercial forest land in the United States has an annual growth potential of more than 85 cubic feet per acre. Less than one-half of 1 percent of the New Mexico forest land has such high production capacity. Reliable potential yield estimates are available only for the ponderosa pine type in New Mexico. The following tabulation compares the percent of commercial forest land within productivity classes of the ponderosa pine type in New Mexico with the average for all forest types in the country:

Productivity Class *(Cu. ft. per acre, per year)*	New Mexico *(Percent)*	U.S.A. *(Percent)*
120 or more	0.0	8.5
85-120	0.2	22.9
50-85	16.6	45.6
20-50	83.2	23.0

Site index, which is based on tree height in relation to age,[5] is another measure that is frequently used to estimate relative site quality for a species. The following tabulation indicates the distribution of ponderosa pine area by site index classes:

Site index class	*Percent*	Site index class	*Percent*
40	17	80	4
50	27	90	1
60	35	100	[1]
70	16	110	[1]

[1] *Less than 0.05 percent*

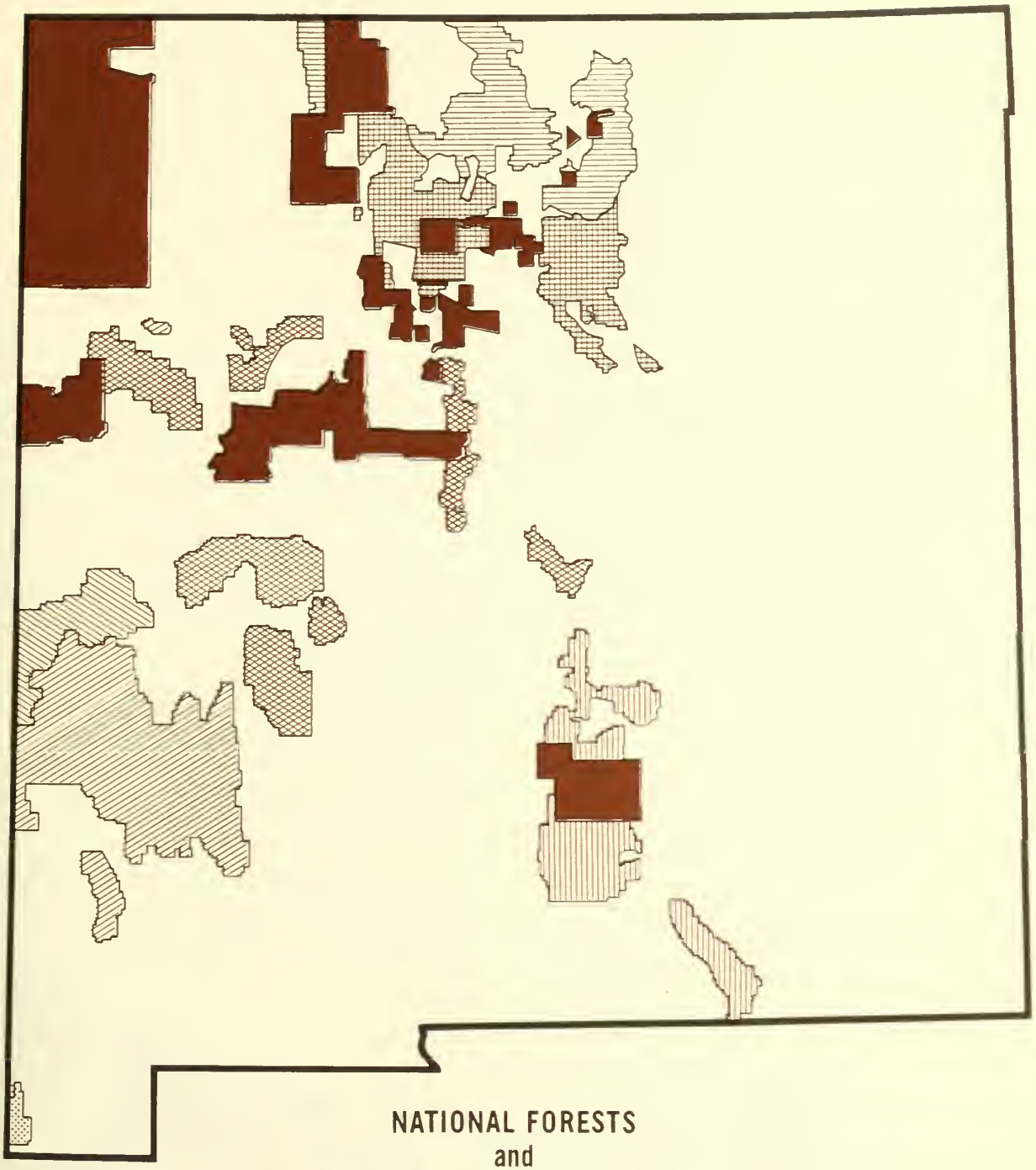
Although more data are needed from other States before precise comparisons are possible, undoubtedly site index for ponderosa pine is relatively low in New Mexico.

Ownership is largely in public and farm holdings

The ownership situation is one of the most important factors that bear on the economic development of forest lands in New Mexico. Here, as in the other Mountain States, the bulk of the forest area is managed by public agencies. Although 69 percent of the commercial forest land of New Mexico is publicly owned, this is less than the average for the Mountain States area (77 percent) and is also the lowest of any of the individual States except Nevada. The following tabulation shows the forest land ownership in New Mexico:

	All forest *(Thousand acres)*	Commercial forest *(Thousand acres)*
Public		
National Forest	7,267	3,458
Indian	2,885	617
Bureau of Land Management	1,429	77
Miscellaneous Federal	120	9
State	933	172
Total public	12,634	4,333
Private		
Farmer	5,074	1,557
Miscellaneous	479	379
Total private	5,553	1,936
All	18,187	6,269

[5] *Site index is the height in feet of average dominant and codominant trees at specified age (100 years in the case of ponderosa pine). For example, site index 70 for ponderosa pine means that the dominant and codominant trees on the area referred to average, have averaged, or will average 70 feet in 100 years.*



NATIONAL FORESTS
and
LAND IN INDIAN RESERVATIONS

Land in Indian Reservations

National Forests, by name:

Apache

Carson

Cibola

Coronado

Gila

Lincoln

Santa Fe

Almost three-fourths of the commercial sawtimber volume in the State is in public administration. The distribution of the total volume by class of owner is as follows:

	Million board feet
National Forest	**14,859**
Indian	**5,284**
Bureau of Land Management	**296**
Miscellaneous Federal	**45**
State	**618**
Private	**7,241**
Total	**28,343**

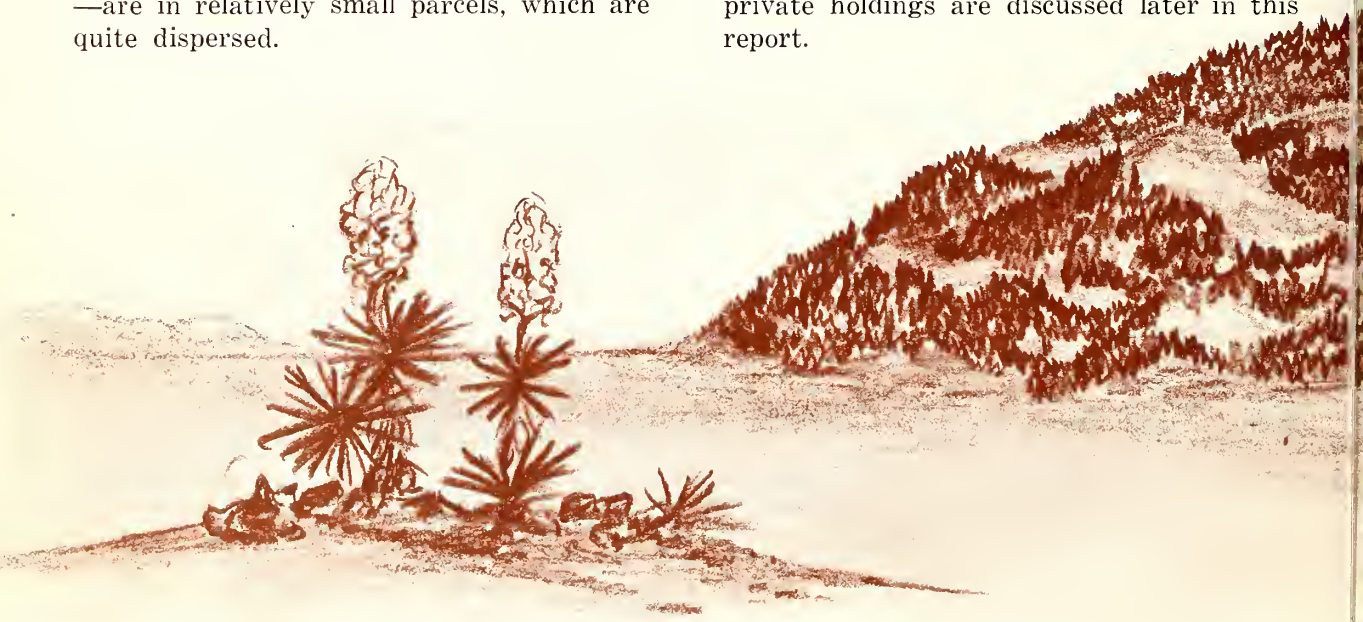
Ninety-four percent of the commercial forest area under public administration is found on Indian lands and the seven National Forests located wholly or partly within New Mexico. One of these National Forests, the Santa Fe, includes what was once the Pecos River Forest Reserve—one of the first areas in the country set aside for preservation of watershed and timber values.

The principal commercial forest areas on Indian lands are within the large reservations—Mescalero, Navajo, Jicarilla, United Pueblos, and Zuni. These lands, under Federal trusteeship, are managed under about the same policies as National Forests. The map on the previous page shows the area in Indian Reservations, as well as the National Forests. Other publicly administered commercial forest lands—principally Bureau of Land Management and State of New Mexico —are in relatively small parcels, which are quite dispersed.

There are substantial differences among principal species in the proportion of sawtimber volume that is in public ownership as reflected in the following tabulation:

	Percent in public
Ponderosa pine	**88**
True firs	**71**
Engelmann spruce	**62**
Douglas-fir	**59**
Aspen	**22**

Private holdings comprise 31 percent of the commercial area and are of several types: Some are in the big Spanish land grants in the northern part of the State; others are owned by forest industries; the bulk (80 percent of the area), however, is owned by farmers and ranchers. A 1953 survey (U.S. Forest Service 1958) showed that there were about 2,000 private owners of commercial forest and of these, 88 percent were farmers or ranchers. This percentage is twice that of the Mountain States area as a whole and is substantially higher than that of any of the individual States. The situation is probably about the same now as it was in 1953. Because of the State's high percentage of small owners, most of whom have little interest in forest management, New Mexico is especially handicapped in its timber resource. Some of the opportunities and problems with respect to management of small private holdings are discussed later in this report.



Management Problems and Opportunities

Timber supplies will support a bigger cut

Timber marketing in New Mexico is beset by the same problems encountered throughout the Rocky Mountains. A few of these problems are less serious than in other areas, but most of them are just as difficult to solve as elsewhere. These include: inadequate markets; a preponderance of old-growth timber that is risky to hold and expensive to protect; slow growth of trees; low volumes per acre and poor quality timber as compared with the west coast and other major producing areas; soils that are easily damaged; and difficult regeneration problems. Other adverse factors are an inadequate road system, a backlog of stand improvement work, and disinterest in timber management by most private owners with small holdings. The need for managing timber with regard to water, recreation, and other forest uses is still another problem—one that may well become the most important, and the most difficult to solve.

The previous description of timber supply and demand in New Mexico provides many indications that industry is not using nearly all the wood suitable for harvesting each year. One clue is that annual cut is merely 0.6 percent of inventory. While this is only slightly less than the cutting rate for the Mountain States as a whole, it is far below the 1.08 percent rate for Arizona where timber stands and the forest environment are not too different from those found in New Mexico. Another indication is the preponderance of old timber. Sawtimber stands occupy 87 percent of the commercial area, and most of the sawtimber trees in these stands are overmature and highly susceptible to diseases, insects, and other losses. Mortality is high.

Accelerated cutting of the old timber would have several results. In addition to whatever immediate benefits would accrue in the form of wages, profits, and taxes, timber management would gain by some alleviation of the problems connected with protecting old growth from catastrophic losses. However, future benefits could be even greater. A more rapid harvest of stagnant old growth, accompanied by a vigorous program of regeneration and cultural work, would result in a proportionate increase in the area of fast-growing young stands. This would enhance New Mexico's opportunity to share in meeting projected national demands for timber in the next century. By 2000, which is not far away in terms of the time it takes trees to mature, the demand for timber products in the United States is expected to increase by 81 percent. The market for pulpwood, plywood, and veneer probably will develop much more rapidly and will be about 2.7 times greater by 2000 than it was in 1962 (U.S. Forest Service 1965).

The extent that the cut can be increased depends not only on such factors as markets and progress in road development, but also on management objectives. The effect that management of the forest for water, recreation and so forth will have on timber yields in the future cannot be estimated with much confidence at this time. A much clearer picture will develop as results of current research become available and are applied in making intensive multiple use inventories.

Conservative estimates indicate that a substantial immediate increase in cut on public lands is highly desirable within the framework of sustained yield management for timber, as well as other uses. If markets and timber access are improved, a feasible an-

nual cut would be two to three times the 40 million cubic feet cut in 1962. This would mean an annual cut of between 1.2 and 1.8 percent of inventory. Even the latter would provide a yield of only one-half the annual potential (about 240 million cubic feet).

The trend in timber yields over the next 30 or 40 years will depend not only on present stand conditions but on cutting practices and cultural treatment that are adopted during this period, as well as market demands. Good management, combined with a market for small roundwood as well as saw logs, should, in time, substantially increase the level of cut. The following sections describe some of the approaches to opportunities for enhancing timber use in New Mexico.

Access to timber is inadequate

It should be fairly obvious that before timberlands can be managed efficiently they must be accessible. Access is needed not only for timber harvesting but also for protection, planting, thinning, and other cultural work. Large areas, particularly of public lands, have remained untapped while many areas served by roads have tended to be overcut in the past. In other words, it has not been possible to manage some large timber properties as a whole but rather on a piecemeal basis.

A principal reason that many timberlands are not yet accessible for cutting is that timber values have been too low to bear the cost of roads and still return a profit to the logger. Factors that make these areas submarginal are low volumes per acre, patchiness of timber in some areas, low quality trees, and—in a great many places—very rugged terrain with erosive soils. Construction of roads that will not result in erosion and deterioration of the land for watershed and other values is of primary consideration. Such roads are costly because high construction standards must be established.

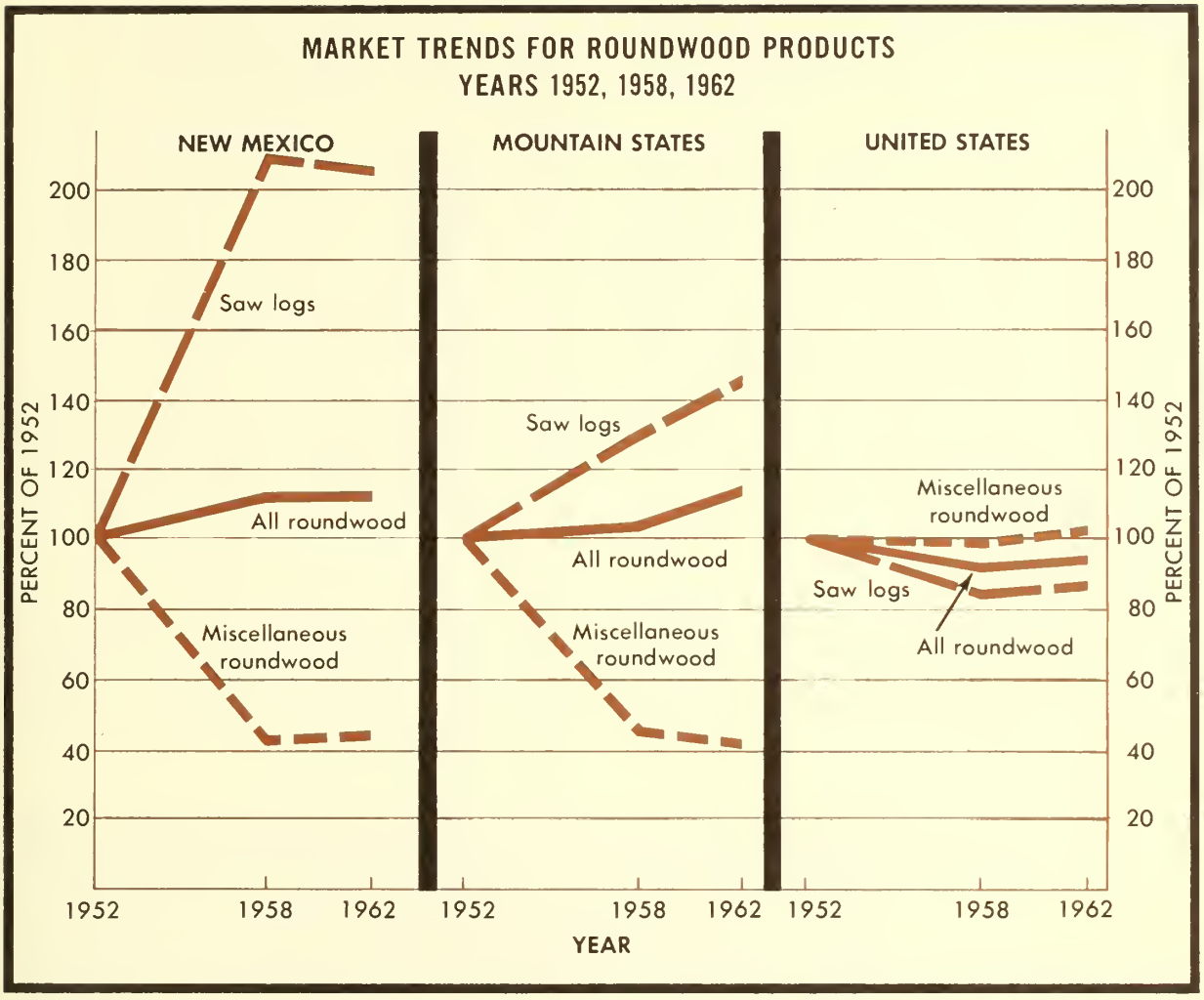
Successful management of the recreation, water, timber, and other resources on public lands depends to a large extent on a multiple-purpose road system. By relieving timber of much of the cost of the primary road system, large areas would become economically operable. The objective on the National Forests in New Mexico for the 10-year period 1963 to 1972 is to build an average of 217 miles of roads a year. This includes reconstruction of many roads that have deteriorated or are inadequate for modern needs. Most of the proposed financing is by direct government appropriations; the remainder is borne by timber operators under sale contracts. So far, annual accomplishments have been less than one-half the goal because of limitations on finances.

Better markets for small timber are needed

Increased use of the timber resource is directly contingent on better markets as well as better access. The total market for roundwood in New Mexico increased 14 percent between 1952 and 1962, thereby keeping pace with the increase for the Mountain States as a whole. This increase appears especially favorable when compared with the 7-percent decrease for the United States during the same period.

Although overall roundwood use has increased, there is at least one very important deficiency in the market situation. Since 1952 New Mexico's timber economy has become highly dependent on saw logs. Of the total market for roundwood products in 1952, saw logs accounted for 43 percent of the volume and other products 57 percent. In 1962 the percentages were 78 and 22, respectively. New Mexico's increase in saw log output between 1952 and 1962 takes on special significance when compared with the trends for both the Mountain States and the nation as a whole (see chart on next page). During this same period, markets for other roundwood decreased sharply in New Mexico, as well as in the Mountain States region as a whole. This was in direct contrast with the slight increase for the nation as a whole.

Important disadvantages are inherent in a timber economy that is heavily dependent



upon saw logs. Timberlands cannot be managed efficiently for saw logs alone. Many mature stands cannot be logged profitably unless there is a market for the smaller trees and for pulpwood chips from saw log residues. Opportunities for commercial thinnings in young stands do not exist without a market for small dimension material.

A substantial market for pulpwood would be a most favorable development. At present no round pulpwood is being cut, and only a small volume of pulp chips is being produced as sawmill byproducts—and these are shipped to out-of-State mills. It is unlikely that there can be any substantial pulpwood market until there is an industry within the State. The greatest gain would be an industry based on the use of roundwood as well as chips. Such a market not only would greatly enhance timber management opportunities but also would provide a profitable outlet for some of the present logging and sawmill residues.

Practically all commercial species in the State are suitable for pulping, and there are large volumes available. Rough estimates indicate that between 400,000 and 500,000 cords of pulpwood are available for annual harvest during the next 20 years at least. A cut of this magnitude not only would be feasible from the standpoint of sustained timber yields, but would be a technically desirable step toward improved timber management. Reliable estimates of just how

much wood is available to serve possible pulpmill sites will require more detailed inventory information than is presently available.

However, the U.S. Forest Service has made some preliminary estimates of pulpwood supplies that could contribute to industrial development in the area of the Northern Rio Grande Resource Conservation and Development Project.[9] These estimates indicate that the Santa Fe and Carson National Forests have the following volumes in trees 5 to 11 inches d.b.h.:

	Million cords
Softwoods	**4.7**
Hardwoods	**.4**
Total	**5.1**

[9]*A cooperative project (State and Federal agencies) created to improve the economic development within an area of 2.9 million acres in Taos, Rio Arriba, Sandoval, Los Alamos, Mora, and Santa Fe Counties.*

Roughly one-half of this volume is presently available for harvest. Several times this volume could be cut on lands in other ownerships within or close to the Project area. Roundwood as well as chips from sawmill residues (estimated annual potential of 92,000 units) would be an adequate supply for a medium-sized mill.[10]

Poles and posts are other products that hold greatest promise for expanding the market for timber of less than saw log size. About 235,000 posts were produced in New Mexico in 1962 and abundant material is available for expansion of this market. Market opportunities for utility poles are much

[10]*The University of New Mexico has been contracted by the Southwestern Region of the U.S. Forest Service to determine the feasibility of a pulpmill in northern New Mexico. Particularly important problems to be studied are wood supplies, adequacy of water for mill operation, and effluent handling.*

Treating plant of the Shollenbarger and Cazolla Lumber Company in Springer. This plant, which pressure treats thousands of poles and posts each year, is one of the few plants in New Mexico that specializes in small roundwood products.
Photo by Ewing McClain, Soil Conservation Service.

more limited because of rigid grade specifications and the relatively small area of sites suitable for pole production. Nevertheless, there are areas where poles can be produced in less time than sawtimber under good management. As pointed out by Mueller (1958), poles bring substantially higher returns per unit volume than saw logs. Both ponderosa pine and Douglas-fir are approved species for poles. However, ponderosa pine is more suitable for poles as well as posts because it is easier to treat.

Opportunities also exist for expanding the market for sawtimber-size material. Better quality control in manufacturing lumber is one approach; development of more types of products is another. Some of the improvement in quality of lumber in recent years has been the result of the trend towards fewer but larger and more efficient mills. In general, large mills are better equipped than small mills. For example, a study conducted in 1959 of certain aspects of the sawmill industry in New Mexico (Gray 1962) pointed out the following relationship between sawmill size and planing equipment:

Mill-size class *(Thousand board feet of production in 1959)*	Mill with planers *(Percent)*
50 or less	0
51 to 1,000	43
1,001 to 5,000	62
5,001 to 15,000	58
15,001 and over	75
Average	46

Similar relationships were noted in terms of other equipment—resaws, edgers, and trimmers.

The great preponderance of low grade ponderosa pine is a principal factor that has limited the variety of timber products from sawtimber in New Mexico. Some material of sawtimber size goes into round mine and farm timbers, poles, and miscellaneous industrial wood, but the great bulk is sawed into lumber—principally boards—as shown by the following results of the survey mentioned above (Gray 1962):

Lumber product	*Percent of all lumber*
Boards	84
Studs	11
Cants	3
Ties	1
Other[1]	1
Total	100

[1]*Mostly mine timbers*

Recent studies have been conducted regarding technical aspects of manufacturing a number of products other than lumber from sawtimber trees. One study (Barger 1965) was made to determine whether or not veneer volume and grade recovery from southwestern ponderosa pine is adequate to support a sheathing-grade plywood operation. This was a cooperative study between the U.S. Forest Service and the Southwest Pine Association. Logs of various grades were peeled into 1/10-inch-thick veneer on an 8-foot lathe under normal operating conditions of a commercial mill. Although results have not been published, preliminary indications are that a very satisfactory veneer output is possible from some material presently going into lumber.

Other studies at the Forest Products Laboratory (Barger and Fleischer 1964) indicate the technical feasibility of producing a variety of products from both low-grade lumber and low-grade timber. Overlaid siding, laminated beams, and laminated flooring can be produced from knotty material in standard lumber sizes through selective cutting, masking, and preassembly methods. Commercially acceptable grades of veneer, plywood, and particle board were also produced in these tests. If it is economically feasible to produce some of these materials, there will be a desirable broadening of the timber industry's base.

Reforestation and cultural work will increase future yields

The effort that is put into reforestation and stand improvement within the next few years can have an important bearing on timber supplies during the next generation or two. Trees take a long time to mature in

Planting ponderosa pine by machine on the Santa Fe National Forest. Of the 1,624 acres artificially regenerated on the National Forests in 1964, 924 acres were planted and 700 acres seeded. Seeding is more efficient than planting under certain conditions. A heavy cover of oak brush, such as seen here, has taken over big areas of ponderosa pine timberland in New Mexico. It must be removed or killed for successful reforestation. Aerial spraying of herbicides has been used successfully to kill it in some areas.

New Mexico—about 120 years for most species. Thinning in overstocked stands can substantially reduce the time necessary for trees to grow to a size desirable for such products as saw logs or commercial poles. At least 50 to 60 years must elapse before present stand improvement work can bear fruit in the form of products from intermediate or final cuts in stands that were thinned or pruned at an early age.

A very substantial area is currently in need of improvement of one type or another. Just how much work is needed cannot be estimated with reasonable accuracy until detailed inventories have been made. Such surveys are underway on many lands. National Forests, for example, are currently examining their lands on practically an acre-by-acre basis to determine the amount and type of work needed for management of timber and other values. Although these surveys will take many years to complete, data from more general surveys provide a basis for preliminary or interim estimates. These estimates are used in the following discussion.

About 220,000 acres are either denuded or stocked with less than 10 percent of the desirable number of trees per acre and need regeneration. In addition to this, part of the 2.1 million acres now poorly stocked (10-40 percent) should also be planted or seeded. The greatest share of the lands in need of regeneration is best suited for growing ponderosa pine. Successful regeneration of this species, either naturally or artificially, is usually dependent on thorough site preparation and protection from animals.

The amount of reforestation work that is presently being done in New Mexico falls far short of the effort necessary to put forest lands in shape to meet anticipated tim-

Thinned stand of ponderosa pine near Valle Grande Peak, Carson National Forest. This stand has been thinned from 2,000 stems per acre to about 430. Remaining trees are 4 to 7 inches d.b.h. and average 40 feet tall, and 30 years old.

ber demands. In 1964, only 1,907 acres of forest land were planted or seeded—1,624 on National Forests and 283 on private and other holdings. The former is less than one-third of the 5,100 acres that the Forest Service feels would be desirable on an annual basis during the decade 1963 to 1972.

Cultural measures—thinning, releasing, pruning—are necessary for accelerating growth and improving quality of trees that eventually will be harvested. Forest Survey data show about 2.2 million acres as being well stocked (70 percent or better) with trees of all types. However, many of these acres are not fully stocked with desirable trees; i.e., trees of the form, quality, and vigor considered necessary for management as crop trees. Also, many stands have far too many trees to permit optimum growth for sawtimber production. Removal of some of the poorer trees from stands that are still young enough to respond to treatment would accelerate growth of those selected for future harvest.

The Forest Service feels that the current program of stand improvement work on the National Forests should amount to about 72,000 acres a year. A lack of markets for commercial thinnings, and inadequate finances for other work permit only a fraction of desired accomplishments. In 1964 only about 6,500 acres were treated—almost all precommercial thinnings.

A much more vigorous program of reforestation and timber stand improvement could provide several benefits to the people of New Mexico. The big backlog of such work on public lands is particularly significant in view of recent national attention to improving the lot of economically depressed communities—such as many of those within the six counties included in the Northern Rio Grande Conservation and Development Project. Within this project area, on Na-

tional Forest lands alone there are about 52,500 acres of better sites that need precommercial thinning to accelerate growth of potential crop trees, and 21,800 acres of denuded land that should be reforested. A substantial amount of labor would be needed for this work. Therefore, such a program would provide immediate economic assistance to the local area, and at the same time be of long-range benefit to one of the State's important natural resources.

Most farm and ranch holdings are not managed for timber production

Although a big job faces managers of public lands, progress is much greater than on private lands—where most owners have primary objectives other than timber management. This poses an important problem when considering future timber development in the State because it involves 1.9 million acres or 31 percent of the commercial forest area.

New Mexico is not unique in having to face this problem. However, the problem is more acute in New Mexico because a very high proportion (88 percent) of the private forest area is in farm and ranch ownership. As indicated earlier, this is twice the average for the Mountain States as a whole.

Traditionally, most farm and ranch owners either feel little would be gained by managing forests for a higher level of timber production, or do not know how to go about it. This was substantiated by a survey conducted among private owners in the northern part of New Mexico. Most of the owners indicated that their forest lands were used primarily for grazing; only 26 percent of them managed for timber production (Gray 1963).

What management work is needed on most private lands? Superficially, the present general condition of private lands compares favorably with the average of all lands. The growth rate on private lands is probably at least as high as the average for the State, and both cubic- and board-foot volumes per acre are only slightly less. The proportion of the area that is in sawtimber stands is practically the same on private as on all lands. However, this type of information is not adequate to assess management opportunities and problems. Detailed surveys are needed to determine site capability and tree quality as well as stocking and spacing of regeneration. The fact that such surveys are not being made on most private holdings is one indication of the problem of improving management.

What services are available to private owners? Actually, there are quite a few sources, both public and private. The New Mexico Department of State Forestry is one important source. This State agency, in addition to the responsibility for fire protection on nearly two million acres of State and private lands, provides management advice to private forest land owners. During fiscal year 1963-64, assistance was given 63 landowners whose combined holdings totaled 209,375 acres. The State of New Mexico Department of Development is another State agency that can assist private enterprise, particularly in industrial development. Federal agencies that work with private owners include the Southwestern Region of the Forest Service and the Soil Conservation Service. The Western Wood Products Association also has been active in assisting private owners through its tree farm program. There are now 11 tree farms totaling 206,644 acres in New Mexico. Many out-of-State forestry consultants are available to aid New Mexico's private owners.

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Appendix

Terminology

Forest Land

The term *forest land* includes (a) land which is at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; (b) land from which the trees described in (a) have been removed to less than 10 percent stocking; and which has not been developed for other use; (c) afforested areas.

At the time the fieldwork for this report was performed, the minimum unit of area for forest land classification was 10 acres with a minimum width of stringer strips of 120 feet.

The principal classes of forest land are:

Commercial forest land. — Forest land which is (a) producing, or is physically capable of producing, usable crops of wood (usually sawtimber); (b) economically available now or prospectively; (c) not withdrawn from timber utilization.

Noncommercial forest land. — Three classes of noncommercial forest land are recognized: *Productive-reserved*, *Unproductive-nonreserved*, and *Unproductive-reserved*.

Productive-reserved is public forest land withdrawn from timber utilization through statute, ordinance, or administrative order, but which otherwise qualifies as commercial forest land.

Unproductive indicates forest land incapable of yielding usable wood products (usually sawtimber) because of adverse site conditions or forest land so physically inaccessible as to be unavailable economically in the foreseeable future.

Forest Types

Forest land is classified into types on the basis of tree species; the type name is that of the predominant species. The predominant species is the one which has a plurality of (a) gross cubic volume in sawtimber and poletimber stands, or (b) the number of stems in seedling and sapling stands. Both growing stock and cull trees are considered in the classification. Forest types which occur on both commercial and noncommercial forest land are:

Douglas-fir	Fir-spruce
Ponderosa pine	Limber pine[9]
	Aspen

Additional forest types which occur only on noncommercial forest land are:

Pinyon-juniper

Chaparral

Other (unclassified)

Tree-Size Classes

Sawtimber-size tree

A tree 9.0 inches d.b.h. or larger for softwoods and 11.0 inches d.b.h. or larger for hardwoods.

Pole-size tree

A tree 5.0 to 8.9 inches d.b.h. for softwoods and 5.0 to 10.9 inches d.b.h. for hardwoods.

Sapling-seedling trees

Trees at least 1-foot high and less than 5.0 inches d.b.h.

[9] *Although the limber pine type was considered commercial forest at the time of the inventory (1962) and is included as such in the appendix tables, it has subsequently been classed as noncommercial by Forest Survey.*

Tree-Merchantability Classes

Sawtimber tree

Live tree of commercial species, 9.0 inches d.b.h. or larger for softwoods and 11.0 inches d.b.h. or larger for hardwoods, that contains at least one 12-foot log to a merchantable top diameter and having the likelihood of eventually containing at least a 16-foot minimum saw log. Also, at least one-third of the board-foot volume must be free from rot or other defect.

Poletimber tree

Live tree of commercial species, 5.0 to 8.9 inches d.b.h. for softwoods and 5.0 to 10.9 inches d.b.h. for hardwoods, free of rot and having the likelihood of growing into a sawtimber tree.

Sapling and seedling trees

Live trees of commercial species, less than 5.0 inches d.b.h., with form and quality to qualify as potential poletimber trees.

Growing stock trees

Sawtimber trees, poletimber trees, saplings and seedlings; i.e., all live trees except cull trees.

In discussion and tables on volumes, growth, and mortality, the term *growing stock* refers only to sawtimber trees and poletimber trees; i.e., all live trees 5.0 inches d.b.h. and larger (except cull trees). Saplings and seedlings are not part of growing stock in this usage of the term.

Cull tree

Live tree of sawtimber or poletimber size that is unmerchantable for saw logs, now or prospectively, because of rot or other defect, or species.

Sound cull trees include:

a. Sawtimber-size trees that have more than two-thirds of their gross board-foot volume in cull with at least one-half of this cull the result of sweep, crook, or other sound defect. Also included are sound trees which do not contain at least one 12-foot saw log.

b. Poletimber-size trees that are unlikely to grow into sawtimber trees because of serious fire and basal scars, broken tops, severe mistletoe, crooks, or girdling by porcupine. No rot may be present.

Rotten cull trees include:

a. Sawtimber-size trees that have more than two-thirds of their gross board-foot volume in cull, with more than half of the cull due to rot.

b. Poletimber-size trees showing any evidence of rot in the main stem.

Mortality tree

A tree 5.0 inches d.b.h. or larger, standing or down, which has died within the past 5 years and was not a cull tree at time of death.

Salvable dead tree

Dead tree 5.0 inches d.b.h. or larger, standing or down (but not lying on the ground) which has 50 percent or more of its cubic-foot volume in sound wood.

Stand-Size Classes

Sawtimber stands

A stand at least 10 percent stocked, with half or more of this stocking in sawtimber and poletimber trees and with sawtimber stocking at least equal to poletimber stocking.

Old-growth sawtimber.—A sawtimber stand in which 50 percent or more of the net board-foot volume is in trees of rotation age or older.

Young-growth sawtimber. — A sawtimber stand in which 50 percent or more of the net board-foot volume is in trees under rotation age.

Poletimber stand

A stand at least 10 percent stocked, with half or more of this stocking in sawtimber and or poletimber trees and with poletimber stocking exceeding that of sawtimber stocking.

Sapling and seedling stand

A stand at least 10 percent stocked, with more than half of this stocking in saplings and/or seedlings.

Nonstocked area

An area not qualifying as a sawtimber, poletimber, or a seedling-sapling stand; i.e., normally an area less than 10 percent stocked.

Stocking

Stocking is a measure of the degree to which growing space is utilized by live trees. In this report it is expressed as the percentage of the available space that is occupied by tree crowns as viewed on aerial photographs.

Well-stocked stand

A stand that is 70 percent or more covered by tree crowns.

Medium-stocked stand

A stand with 40 to 70 percent coverage by tree crowns.

Poorly-stocked stand

A stand with 10 to 40 percent coverage by tree crowns.

Nonstocked area

An area with less than 10 percent coverage by tree crowns.

Timber Volume

All-timber volume

Volume in cubic feet of sound wood in the bole of growing stock, cull, and salvable dead trees 5.0 inches and larger in diameter at breast height, from stump to a minimum 4.0-inch top inside bark.

Growing stock volume

Net volume in cubic feet of sawtimber trees and poletimber trees from stump to a minimum 4.0-inch top inside bark.

Live sawtimber volume

Net volume in board feet, International ¼-inch rule, of the saw log portion of sawtimber trees.

Saw log portion

That portion of the bole of sawtimber trees between the stump and the merchantable top.

Merchantable top

The point at which the upper limit of saw log merchantability is limited either by limbs or by a minimum diameter. The latter ranges from 5 to 10 inches inside bark depending on d.b.h. and species.

Upper-stem portion

That part of the bole of sawtimber trees above the merchantable top to a minimum top diameter of 4.0 inches inside bark.

Quality class

A classification of sawtimber volume in terms of log grades. Four grades are recognized and distinguished by the occurrence and characteristics of knots. The log grades corresponding to the quality classes are:

Grade 1 (select logs) are essentially smooth and surface clear, except that in logs 16 inches and larger in diameter a few visible knots are permitted, providing there are no more than 1 large knot, or 2 medium or small knots, or 4 pin knots. Knot sizes for all grades are:

Pin knots — 0.5 inch or less

Small knots — 0.5 to 0.75 inch

Medium knots — 0.75 to 1.5 inches

Large knots — over 1.5 inches

Occasionally, logs with a greater number of knots are admitted provided these knots may be boxed in an area not exceeding one-third the area of one face or an equivalent area of two faces.

Grade 2 (shop logs) display relatively few knots of any size, so spaced that at least 50 percent of the surface of the log is in smooth, clear areas, the size of which must be at least one-fourth the girth of the log in width, by 4 feet or more in length.

A log with no more than 12 medium or smaller knots, or more than 8 large ones, may be immediately classed as grade 2. If this number of knots is exceeded, the clear area basis governs.

Grade 3 (common logs) display either (a) pin, small, or medium knots of which 80 percent are either live or will cut out red (intergrown) beneath the slab, or (b) 16 dead knots (an average of 4 per face) averaging medium in size.

Grade 4 (low common logs) display medium, large, and very large live and/or dead knots in excess of the numbers permitted in grades 2 and 3.

Growth

Net annual growth of sawtimber or growing stock

The average annual change, calculated from the total change over a 10-year period, in net board-foot or cubic-foot volume of live sawtimber or growing stock on commercial forest land.

Mortality

Net annual mortality of sawtimber or growing stock

The average annual net board-foot or cubic-foot volume removed from live sawtimber or growing stock through death, calculated from the total net volume removed by such causes over a 10-year period.

Timber Cut

Timber cut from growing stock

The volume of sound wood in live sawtimber and poletimber trees cut for forest products during a specified period, including both roundwood products and logging residues.

Timber cut from sawtimber

The net board-foot volume of live sawtimber trees cut for forest products during a specified period, including both roundwood products and logging residues.

Logging residues from growing stock

The net cubic-foot volume of live sawtimber and poletimber trees cut or killed by logging on commercial forest land and not converted to timber products.

Ownership Classes

National Forest lands

Federal lands which have been designated by Executive order or statute as National Forests or purchase units, and other lands under the administration of the Forest Service, including experimental areas.

Other Federal lands

Federal lands other than National Forests, including lands administered by the Bureau of Land Management, Bureau of Indian Affairs, and miscellaneous Federal agencies.

State lands

Lands owned by the State.

Forest industry lands

Lands owned by companies or individuals operating wood-using plants.

Farmer-owned lands

Lands owned by operators of farms or ranches.

Miscellaneous private lands

Privately owned lands other than forest-industry or farmer-owned lands.

Principal Tree Species

Softwoods

Douglas-fir	*Pseudotsuga menziesii*
Fir, subalpine	*Abies lasiocarpa*
Fir, corkbark	*A. lasiocarpa arizonica*
Fir, white	*A. concolor*
Juniper	*Juniperus spp.*
Pine, limber	*Pinus flexilis*
Pine, ponderosa	*P. ponderosa*
Pinyon	*P. spp.*
Spruce, Engelmann	*Picea engelmannii*

Hardwoods

Aspen, quaking	*Populus tremuloides*
Cottonwood	*Populus spp.*

Survey Methods

Area statistics were determined by two methods:[11] (1) On National Forests, forest lands were mapped on aerial photographs according to forest type, stand size, and crown density. Photo delineations were transferred to base maps. Maps were then dot counted to obtain the estimates of area by the various land and forest classes. (2) For all lands not in National Forest ownership (except certain Indian Reservations), a sampling procedure was used. Points were classified on aerial photos to determine the proportion of area by forest versus nonforest, class of forest, and ownership. A percentage of the points was checked on the ground for correctness of classification. Results of the field check were then used to adjust photo estimates of proportions. Acreages were determined by applying the adjusted proportions to the total acreage of the sampled area.

Volume estimates are based on tree measurements taken on 5,202 sample areas located at random on commercial forest land. Sample locations were pricked on aerial photos. These were then located in the field and marked to permit remeasurement in future surveys. Two different sampling procedures were used: (1) On National Forests, measurements were taken on circular plots of fixed radius. Each plot consisted of four circular and concentric subplots. The area of subplots and size class of trees (live and dead) of commercial species tallied on each are as follows:

1/250-acre — seedlings
1/50-acre — saplings
1/10-acre — pole-size
1/4-acre — sawtimber-size

(2) On lands not in National Forest ownership, sample locations were approximately 1 acre in size. Each location was subsampled at 10 points. At each point, trees were tallied on two plots — one of fixed radius (1/250-acre) and one of variable radius. On the former, all trees were measured and live noncull trees were classified as crop trees or excess trees from the standpoint of management treatment. The variable radius plot (trees are sampled in proportion to their basal area) was used for live sawtimber trees and for mortality sawtimber trees.

Both of the systems described above included the customary measurements and classifications of trees for volume and quality. Increment borings were taken for growth estimates.

Per-acre values of volume, growth, and mortality were obtained from the field samples. These averages, applied to area estimates, provided volumes shown in appendix tables.

Estimates of timber cut are based on periodic surveys of forest industries. The latest survey was in 1962 and is the basis for data shown in the appendix tables. Utilization trends discussed in the text are based mainly on lumber production data, since information on output of all products is available only for 1952, 1960, and 1962.

[11] *Methods described here are those that were used for inventorying all forest lands except those within the Mescalero, Navajo, Ute Mountain, Zuni, Jicarilla, and United Pueblo Indian Reservations. Data for these lands were provided by the Bureau of Indian Affairs from their management plan inventories.*

Reliability of Estimates

Accuracy objectives for the timber inventory of New Mexico were as follows:

	Allowable error[1]
Commercial forest area	3 percent per million acres
Noncommercial forest area	10 percent per million acres
Growing stock volume on commercial forest land	10 percent per billion cubic feet
Net annual growth of growing stock on commercial forest land	15 percent per billion cubic feet

[1]*In terms of one standard error.*

Sampling errors actually obtained for the State as a whole are not known. They have been computed for certain parts of the State from basic data provided by some of the several agencies that made inventories of their own lands. For certain large areas, however, the basic field and photo data necessary for computing errors are not available.

The following sampling errors have been computed for timber cut and timber products output in 1962:

	Volume	*Sampling error*[1] *(Percent)*
Timber cut from growing stock	39,601 M cu. ft.	10.3
Timber cut from sawtimber	241,412 M bd. ft.	10.9
Timber products output	46,259 M cu. ft.	10.2

[1]*In terms of one standard error.*

Timber Statistics

Table 1.—**Area by land classes, New Mexico, 1962**

Land class	Thousand acres
Commercial forest land	6,269
Unproductive forest land	11,357
Productive-reserved forest land	561
Total forest land	18,187
Nonforest land	59,579
All land	[1]77,766

[1]*From U.S. Bureau of the Census, Land and Water Areas of the Unted States, 1960.*

Table 2.—**Area of commercial forest land by ownership classes, New Mexico, 1962**

Ownership class	Thousand acres
National Forest	3,458
Other Federal:	
Bureau of Land Management	77
Indian	617
Miscellaneous Federal	9
Total other Federal	703
State	172
Farmer-owned	1,557
Miscellaneous private[1]	379
All ownerships	6,269

[1]*Forest industry has been combined with miscellaneous private to avoid disclosure of holdings of an individual owner.*

Table 3.—**Area of commercial forest land by stand-size and by ownership classes, New Mexico, 1962**

Stand-size class	All ownerships	National Forest	Other Public	Farmer and misc. private
	Thousand acres			
Sawtimber stands:				
Old growth	2,971	1,707	547	717
Young growth	2,483	1,243	286	954
Total	5,454	2,950	833	1,671
Poletimber stands	426	275	19	132
Sapling and seedling stands	169	16	20	133
Nonstocked area	220	217	3	—
All classes	6,269	3,458	875	1,936

Table 4.—**Area of commercial forest land, by stand-volume classes for sawtimber and other stand-size classes, New Mexico, 1962**

Stand volume per acre[1]	Area by stand-size classes		
	All stands	Sawtimber stands	Other stands
	Thousand acres		
Less than 1,500 board feet	1,099	349	750
1,500 to 5,000 board feet	4,312	4,254	58
5,000 to 10,000 board feet	644	642	2
10,000 to 20,000 board feet	209	204	5
More than 20,000 board feet	5	5	—
All classes	6,269	5,454	815

[1]*Net volume, International 1/4-inch rule.*

Table 5.—**Area of commercial forest land, by stocking classes of all live trees and by stand-size classes, New Mexico, 1962**

Stocking class	All stands	Sawtimber stands	Poletimber stands	Sapling and seedling stands	Nonstocked stands
	Thousand acres				
70 percent or more	2,176	2,019	100	57	—
40 to 70 percent	1,779	1,638	120	21	—
10 to 40 percent	2,094	1,797	206	91	—
Less than 10 percent	220	—	—	—	220
All classes	6,269	5,454	426	169	220

Table 6.—**Area of commercial forest land, by forest types and by ownership classes, New Mexico, 1962**

Forest type	All ownerships	Public ownerships	Private ownerships
	Thousand acres		
Douglas-fir	1,000	582	418
Ponderosa pine	4,334	3,262	1,072
Limber pine	43	10	33
Fir-spruce	525	290	235
Aspen	367	189	178
All types	6,269	4,333	1,936

Table 7.—**Area of commercial forest land by forest types and by stand-size classes, New Mexico, 1962**

Forest type	All stands	Sawtimber stands	Poletimber stands	Sapling and seedling stands	Nonstocked stands
			Thousand acres		
Douglas-fir	1,000	902	85	(1)	13
Ponderosa pine	4,334	3,885	154	101	194
Limber pine	43	43	—	—	—
Fir-spruce	525	445	27	40	13
Aspen	367	179	160	28	—
All types	6,269	5,454	426	169	220

[1]*Less than 0.5 thousand acres.*

Table 8.—**Area of noncommercial forest land, by forest types, New Mexico, 1962**

Forest type	All areas	Productive reserved areas	Unproductive areas
		Thousand acres	
Douglas-fir	122	120	2
Ponderosa pine	347	307	40
Limber pine	(1)	(1)	—
Fir-spruce	129	122	7
Aspen	33	12	21
Chaparral	652	—	652
Pinyon-juniper	10,635	—	10,635
All types	11,918	561	11,357

[1]*Less than 0.5 thousand acres.*

Table 9.—**Number of growing-stock trees on commercial forest land, by diameter classes and by softwoods and hardwoods, New Mexico, 1962**

D.B.H. class (inches)	All species	Softwoods	Hardwoods
		Thousand trees	
1.0-2.9	456,992	416,542	40,450
3.0-4.9	284,019	253,972	30,047
5.0-6.9	188,436	166,988	21,448
7.0-8.9	115,489	106,891	8,598
9.0-10.9	77,504	72,471	5,033
11.0-12.9	44,314	41,080	3,234
13.0-14.9	35,410	32,305	3,105
15.0-16.9	23,869	22,273	1,596
17.0-18.9	17,153	16,323	830
19.0-28.9	24,580	24,030	550
29.0-38.9	1,539	1,539	—
39.0 and larger	69	69	—
All classes	1,269,374	1,154,483	114,891

Table 10.—Volume of timber on commercial forest land, by class of timber and by softwoods and hardwoods, New Mexico, 1962

Class of timber	All species	Softwoods	Hardwoods
		Thousand cubic feet	
Sawtimber trees:			
Saw-log portion	5,203,513	5,029,306	174,207
Upper-stem portion	468,663	416,663	52,000
Total	5,672,176	5,445,969	226,207
Poletimber trees	944,063	791,196	152,867
All growing-stock trees	6,616,239	6,237,165	379,074
Sound cull trees:			
Sawtimber-size trees	173,859	127,340	46,519
Poletimber-size trees	113,201	66,014	47,187
Total	287,060	193,354	93,706
Rotten cull trees:			
Sawtimber-size trees	87,464	40,284	47,180
Poletimber-size trees	81,980	9,199	72,781
Total	169,444	49,483	119,961
Salvable dead trees:			
Sawtimber-size trees	373,671	367,137	6,534
Poletimber-size trees	70,043	43,886	26,157
Total	443,714	411,023	32,691
All timber	7,516,457	6,891,025	625,432

Table 11.—Volume of growing stock and sawtimber on commercial forest land, by ownership classes and by softwoods and hardwoods, New Mexico, 1962

Ownership class	All species	Softwoods	Hardwoods
		GROWING STOCK *(Million cubic feet)*	
National Forest	3,387	3,326	61
Other public	1,369	1,341	28
Farmer and misc. private[1]	1,860	1,570	290
All ownerships	6,616	6,237	379
		SAWTIMBER *(Million board feet)*[2]	
National Forest	14,859	14,678	181
Other public	6,243	6,153	90
Farmer and misc. private[1]	7,241	6,279	962
All ownerships	28,343	27,110	1,233

[1]*Forest industry has been combined with miscellaneous private to avoid disclosure of holdings of an individual owner.*
[2]*International 1/4-inch rule.*

Table 12.—**Volume of growing stock and sawtimber on commercial forest land, by stand-size classes and by softwoods and hardwoods, New Mexico, 1962**

Stand-size class	All species	Softwoods	Hardwoods
		GROWING STOCK *Million cubic feet*	
Sawtimber stands	6,320	6,008	312
Poletimber stands	231	164	67
Sapling and seedling stands	38	38	([1])
Nonstocked areas	27	27	([1])
All classes	6,616	6,237	379
		SAWTIMBER *(Million board feet)*[2]	
Sawtimber stands	27,662	26,457	1,205
Poletimber stands	493	466	27
Sapling and seedling stands	63	63	([1])
Nonstocked areas	125	124	1
All classes	28,343	27,110	1,233

[1]*Less than 0.5 million feet.*
[2]*International 1/4-inch rule.*

Table 13.—**Volume of growing stock on commercial forest land by species and diameter classes, New Mexico, 1962**

Species	Diameter class (inches at breast height)										
	All Classes	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-28.9	29.0-38.9	39.0 & larger
	Million cubic feet										
Softwoods:											
Douglas-fir	942	47	83	84	81	121	89	93	298	37	9
Ponderosa pine[1]	3,837	137	175	232	255	349	444	510	1,466	257	12
Limber pine[2]	158	12	25	15	29	26	17	5	25	3	1
True firs[3]	594	115	75	78	61	65	50	35	92	21	2
Engelmann spruce	706	50	72	125	89	81	76	68	125	20	—
Total	6,237	361	430	534	515	642	676	711	2,006	338	24
Hardwoods:											
Aspen	379	54	48	51	50	66	51	31	28	([4])	—
Total	379	54	48	51	50	66	51	31	28	([4])	—
All species	6,616	415	478	585	565	708	727	742	2,034	338	24

[1]*Includes a negligible amount of Apache, Arizona, and Chihuahua pine.*
[2]*Includes a negligible amount of Mexican white and bristlecone pines.*
[3]*Includes subalpine, white, and corkbark firs.*
[4]*Less than 0.5 million cubic feet.*

Table 14—Volume of sawtimber on commercial forest land, by species and diameter classes, New Mexico, 1962

Species	Diameter class (inches at breast height)								
	All classes	9.0-10.9[1]	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-28.9	29.0-38.9	39.0 & larger
	Million board feet[2]								
Softwoods:									
Douglas-fir	5,025	525	485	796	526	584	1,821	229	59
Ponderosa pine[3]	16,188	776	969	1,402	1,950	2,315	7,183	1,502	91
Limber pine[4]	640	77	157	139	89	25	128	20	5
True firs[5]	1,976	327	283	314	246	174	498	123	11
Engelmann spruce	3,281	681	493	454	425	383	722	123	—
Total	27,110	2,386	2,387	3,105	3,236	3,481	10,352	1,997	166
Hardwoods:									
Aspen	1,233	0	265	358	279	170	161	(6)	—
Total	1,233	0	265	358	279	170	161	(6)	—
All species	28,343	2,386	2,652	3,463	3,515	3,651	10,513	1,997	166

[1] *Softwoods only.*
[2] *International 1/4-inch rule.*
[3] *Includes a negligible amount of Apache, Arizona, and Chihuahua pine.*
[4] *Includes a negligible amount of Mexican white and bristlecone pines.*
[5] *Includes subalpine, white, and corkbark firs.*
[6] *Less than 0.5 million board feet.*

Table 15.—Volume of sawtimber on commercial forest land, by species[1] and quality classes, New Mexico, 1962

Species	Quality classes				
	All classes	1	2	3	4
	Million board feet[2]				
Softwoods:					
Ponderosa pine	16,188	139	892	1,674	13,483
Total	16,188	139	892	1,674	13,483

[1] *Ponderosa pine is the only species log-graded.*
[2] *International 1/4-inch rule.*

Table 16.—**Volume of salvable dead saw-timber-size trees on commercial forest land, by softwoods and hardwoods, New Mexico, 1962**

Species group	Volume
	Thousand board feet[1]
Softwoods	1,844,898
Hardwoods	35,657
All species	1,880,555

[1]*International 1/4-inch rule.*

Table 17.—**Net annual growth and annual cut of growing stock on commercial forest land, by species, New Mexico, 1962**

Species	Net annual growth	Annual timber cut
	Thousand cubic feet	
Softwoods:		
Douglas-fir	– 422	7,443
Ponderosa pine[1]	40,543	21,587
True firs[2]	7,536	1,841
Engelmann spruce	14,108	8,465
Limber pine[3]	1,592	260
Total	63,357	39,596
Hardwoods (Aspen)	– 10,257	5
All species	53,100	39,601

[1]*Includes a negligible amount of Apache, Arizona, and Chihuahua pines*
[2]*Includes subalpine, white, and corkbark firs.*
[3]*Includes a negligible amount of Mexican white and bristlecone pines.*

Table 18.—**Annual cut of growing stock on commercial forest land, by ownership classes and by softwoods and hardwoods, New Mexico, 1962**

Species group	All ownerships	National Forest	Other public	Farmer[1] and misc. private
	ANNUAL TIMBER CUT			
	(Thousand cubic feet)			
Softwoods	39,598	20,709	4,474	14,415
Hardwoods	3	3	(2)	(3)
All Species	39,601	20,712	4,474	14,415

[1]*Forest industry has been combined with farmer and miscellaneous private to avoid disclosure of holdings of an individual owner.*
[2]*Less than 0.5 thousand cubic feet.*
[3]*A small quantity of hardwoods has been combined with softwoods to avoid disclosing individual operations.*

Table 19.—**Net annual growth and annual cut of sawtimber on commercial forest land, by species, New Mexico, 1962**

Species	Net annual growth	Annual timber cut
	Thousand board feet[1]	
Softwoods:		
Douglas-fir	–2,367	45,381
Ponderosa pine[2]	153,582	131,558
True firs[3]	9,627	11,104
Engelmann spruce	65,772	51,658
Limber pine[4]	2,759	1,690
Total	229,373	241,391
Hardwoods (Aspen)	–13,183	21
All species	216,190	241,412

[1]*International 1/4-inch rule.*
[2]*Includes a negligible amount of Apache, Arizona, and Chihuahua pines.*
[3]*Includes subalpine, white, and corkbark firs.*
[4]*Includes a negligible amount of Mexican white and bristlecone pines.*

Table 20.—**Annual cut of sawtimber on commercial forest land, by ownership classes and by softwoods and hardwoods, New Mexico, 1962**

Species group	All ownerships	National Forest	Other public	Farmer[1] and misc. private
	ANNUAL TIMBER CUT			
	(Thousand board feet)[2]			
Softwoods	241,399	126,248	27,277	87,874
Hardwoods	13	11	2	([3])
All species	241,412	126,259	27,279	87,874

[1]*Forest industry has been combined with farmer and miscellaneous private to avoid disclosure of holdings of an individual owner.*
[2]*International 1/4-inch rule.*
[3]*A small quantity of hardwoods has been combined with softwoods to avoid disclosing individual operations.*

Table 21.—**Annual mortality of growing stock and sawtimber on commercial forest land, by species, New Mexico, 1962**

Species	Growing stock	Sawtimber
	Thousand cubic feet	*Thousand board feet*[1]
Softwoods:		
Douglas-fir	14,420	77,866
Ponderosa pine[2]	10,156	41,002
Limber pine[3]	564	3,260
True firs[4]	7,147	36,112
Engelmann spruce	878	3,323
Total	33,165	161,563
Hardwoods	20,564	50,280
All species	53,729	211,843

[1]*International 1/4-inch rule.*
[2]*Includes a negligible amount of Apache, Arizona, and Chihuahua pine.*
[3]*Includes a negligible amount of Mexican white and bristlecone pines.*
[4]*Includes subalpine, white, and corkbark firs.*

Table 22.—**Annual mortality of growing stock and sawtimber on commercial forest land, by causes and by softwoods and hardwoods, New Mexico, 1962**

Cause of death	Growing stock			Sawtimber		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	Thousand cubic feet			*Thousand board feet*[1]		
Fire	3,604	3,604	——	6,121	6,121	——
Insects	18,934	11,198	7,736	63,997	59,472	4,525
Disease	26,483	14,031	12,452	116,987	71,232	45,755
Other	4,708	4,332	376	24,738	24,738	—
All causes	53,729	33,165	20,564	211,843	161,563	50,280

[1]*International 1/4-inch rule.*

Table 23.—**Total output of timber products, by products, by type of material used, and by softwoods and hardwoods, New Mexico, 1962**

Product and species group	Total output in standard units		Output from roundwood from growing stock		Output from roundwood from nongrowing stock		Output from plant by-products (standard units)
	Unit	Number	Standard units	M cubic feet	Standard units	M cubic feet	
Saw logs:							
Softwood	M bd. ft.[1]	247,620	225,086	32,638	22,534	3,267	0
Hardwood	M bd. ft.[1]	([3])	([3])	([3])	([3])	([3])	0
Total	M bd. ft.[1]	247,620	225,086	32,638	22,534	3,267	0
Poles:							
Softwood	M pcs.	3	2	15	1	10	0
Hardwood	M pcs.	([4])	([4])	3	([4])	5	0
Total	M pcs.	3	2	18	1	15	0
Mine timbers (round):							
Softwood	M cu. ft.	410	387	387	23	23	0
Hardwood	M cu. ft.	0	0	0	0	0	0
Total	M cu. ft.	410	387	387	23	23	0
Miscellaneous industrial wood:[2]							
Softwood	M cu. ft.	251	176	176	75	75	0
Hardwood	M cu. ft.	23	([3])	([3])	23	23	0
Total	M cu. ft.	274	176	176	98	98	0
Posts:							
Softwood	M pcs.	230	11	12	219	253	0
Hardwood	M pcs.	5	0	0	5	6	0
Total	M pcs.	235	11	12	224	259	0
Fuelwood:							
Softwood	M std. cds.	154	5	361	126	8,777	23
Hardwood	M std. cds.	3	0	0	3	228	0
Total	M std. cds.	157	5	361	129	9,005	23
All products:							
Softwood	M cu. ft.	—	—	33,589	—	12,405	—
Hardwood	M cu ft.	—	—	3	—	262	—
Total	M cu. ft.	—	—	33,592	—	12,667	—

[1]*International 1/4-inch rule.*
[2]*Includes converter poles, excelsior bolts, charcoal wood, and house logs.*
[3]*A small quantity of hardwoods has been combined with softwoods to avoid disclosing individual operations.*
[4]*Less than 0.5 thousand pieces.*

Table 24.—**Total output of roundwood products, by source and by softwoods and hardwoods, New Mexico, 1962**

Source	All species	Softwoods	Hardwoods
	- - - *Thousand cubic feet* - - -		
Growing-stock trees:[1]			
Sawtimber	33,458	33,453	5
Poletimber	134	134	0
Total	33,592	33,587	5
Cull trees[1]	0	0	0
Salvable dead trees[1]	11,596	11,377	219
Other sources[2]	1,071	1,028	43
All sources	46,259	45,992	267

[1]*On commercial forest land.*
[2]*Includes noncommercial forest land, nonforest land such as fence rows, trees less than 5.0 inches in diameter, and tree tops and limbs.*

Table 25.—**Annual timber cut from growing stock on commercial forest lands, by products and logging residues, and by softwoods and hardwoods, New Mexico, 1962**

Products and residues	All species	Softwoods	Hardwoods
	- - - *Thousand cubic feet* - - -		
Roundwood products:			
Saw logs	32,638	32,638	(2)
Poles	18	15	3
Mine timbers	387	387	0
Misc. industrial wood[1]	176	176	(2)
Posts	12	12	0
Fuelwood	361	361	0
All products	33,592	33,589	3
Logging residues	6,009	6.009	0
Timber cut	39,601	39,598	3

[1]*Includes converter poles, excelsior bolts, charcoal wood, and house logs.*
[2]*A small quantity of hardwoods has been combined with softwoods to avoid disclosing individual operations.*

Table 26.—Annual timber cut from live sawtimber on commercial forest lands, by products and logging residues, and by softwoods and hardwoods, New Mexico, 1962

Products and residues	All species	Softwoods	Hardwoods
	Thousand board feet[1]		
Roundwood products:			
Saw logs	225,086	225,086	(2)
Poles	42	35	7
Mine timbers	1,130	1,130	0
Misc. industrial wood[3]	1,160	1,160	(2)
Posts	63	63	0
Fuelwood	312	312	0
All products	227,793	227,786	7
Logging residues	13,619	13,619	0
Timber cut	241,412	241,405	7

[1]*International 1/4-inch rule.*
[2]*A small quantity of hardwoods has been combined with softwoods to avoid disclosing individual operations.*
[3]*Includes converter poles, excelsior bolts, charcoal wood, and house logs.*

Table 27.—Volume of plant residues by industrial source and type of residue, and by softwoods and hardwoods, New Mexico, 1962

Industrial source	Species and character of residues								
	All species			Softwoods			Hardwoods		
	Total	Coarse[1]	Fine[2]	Total	Coarse	Fine	Total	Coarse	Fine
	Thousand cubic feet								
Lumber industry	17,790	8,378	9,412	17,790	8,378	9,412	0	0	0
Veneer and plywood industry	0	0	0	0	0	0	0	0	0
Other primary industries	53	53	0	49	49	0	4	4	0
All industries	17,843	8,431	9,412	17,839	8,427	9,412	4	4	0

[1]*Unused material suitable for chipping, such as slabs, edgings, and veneer cores.*
[2]*Unused material not suitable for chipping, such as sawdust and shavings.*

Table 28.—**Timber growth projections, all species, New Mexico, 1962-92**[1]

Period	Assumed cut	Projected growth
	GROWING STOCK *(Thousand cubic feet)*	
1962	39,601	53,100
1972	69,600	70,800
1982	93,400	86,500
1992	116,000	100,900
	SAWTIMBER *(Thousand board feet)*[2]	
1962	241,412	216,190
1972	309,100	236,300
1982	367,400	252,600
1992	423,800	268,300

[1]*These projections assume that: (1) There will be practically no change in the area of commercial forest land, (2) demands for timber products will rise along with predicted increases in the nation's population and income, (3) timber will maintain its market position relative to competitive materials, and (4) timber management will become more intensive, especially with respect to improving the number, spacing, vigor, and age-class distribution of trees.*

[2]*International 1/4-inch rule.*

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AND
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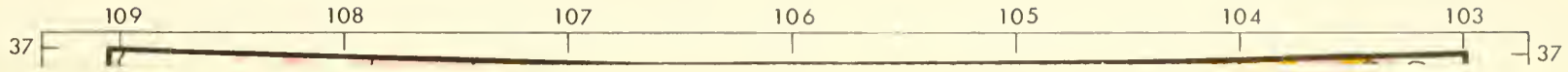

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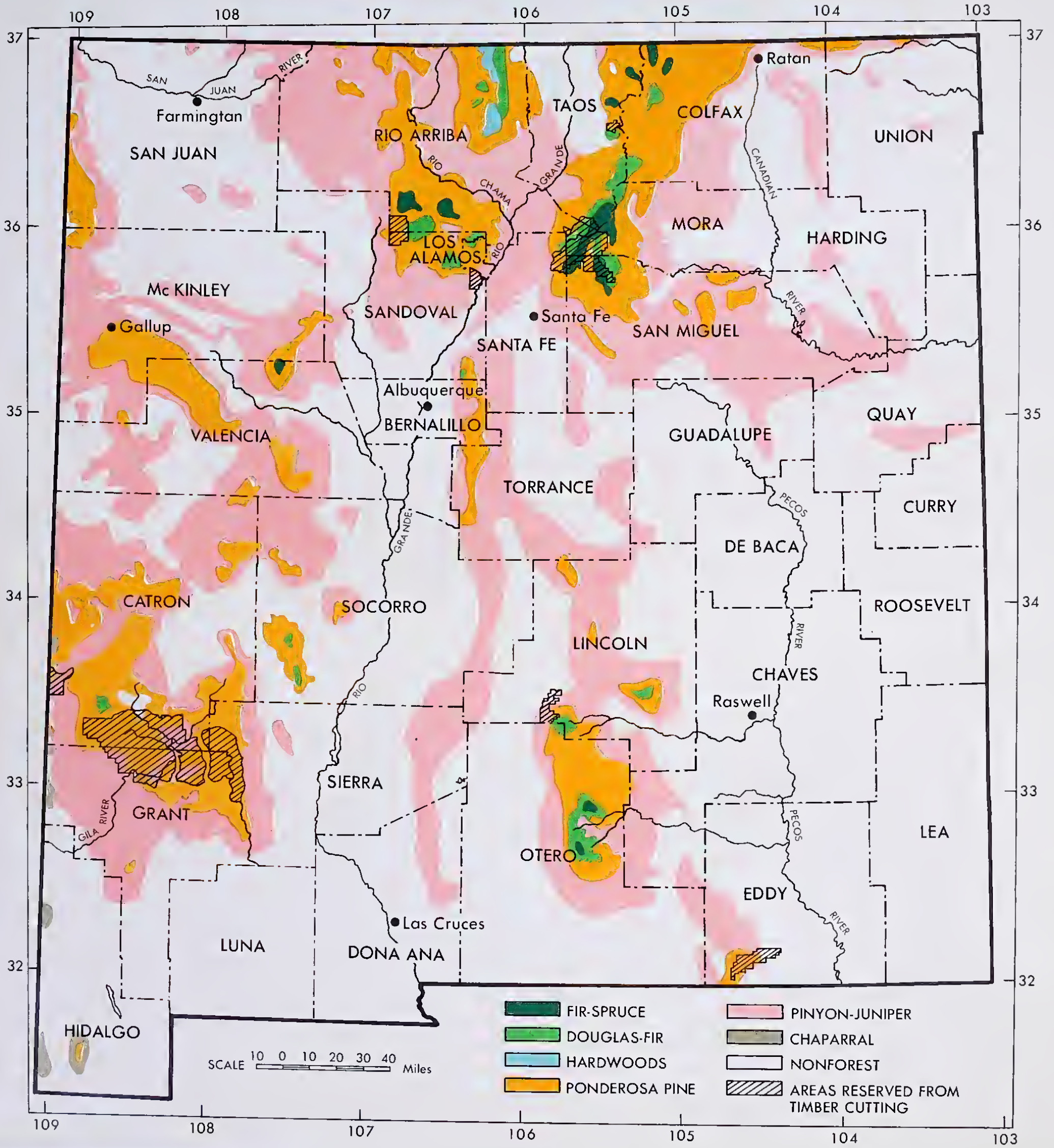

RECENT FOREST SURVEY PUBLICATIONS

Title	Number	Date
Timber Resources of Idaho	Forest Survey Release No. 3	1962
The Forest Resources of Western Montana	Resource Bulletin INT-1	1963
*The Forests of Wyoming	Resource Bulletin INT-2	1963
*The Forest Resources of Colorado	Resource Bulletin INT-3	1964
Output of Timber Products in Montana, 1962	Research Paper INT-11	1964
Forest Products Output in Utah and Nevada, 1962	Research Paper INT-12	1964
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*Timber Products Output in Colorado, Wyoming, and Western South Dakota	Research Paper INT-14	1964
*Timber Products Output in Arizona and New Mexico, 1962	Research Paper INT-15	1964
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Site Index Curves for Engelmann Spruce in the Northern and Central Rocky Mountains	Research Note INT-42	1966

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